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RESEARCH DEVELOPMENT

TEST & EVALUATION

MARINE CORPS
LANDING FORCE DEVELOPMENT CENTER
MARINE CORPS SCHOOLS
QUANTICO, VIRGINIA

PROJECT NO. 20-63-01
COMPARATIVE EVALUATION OF
REPUBLIC "BIKINI" DRONE SYSTEM
RYAN "FLEX BEE" DRONE SYSTEM
FINAL REPORT

Opinions, conclusions, and recommendations contained in this report are those of the Marine Corps Landing Force Development Center and are not to be construed as reflecting the view or endorsement of the Commandant of the Marine Corps.

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MARINE CORPS LANDING FORCE DEVELOPMENT CENTER
Marine Corps Schools
Quantico, Virginia, 22134

CLASSIFICATION: Unclassified

PROJECT NO.: 20-63-01

SUBJECT: Lightweight Battlefield Surveillance Drones

ABSTRACT

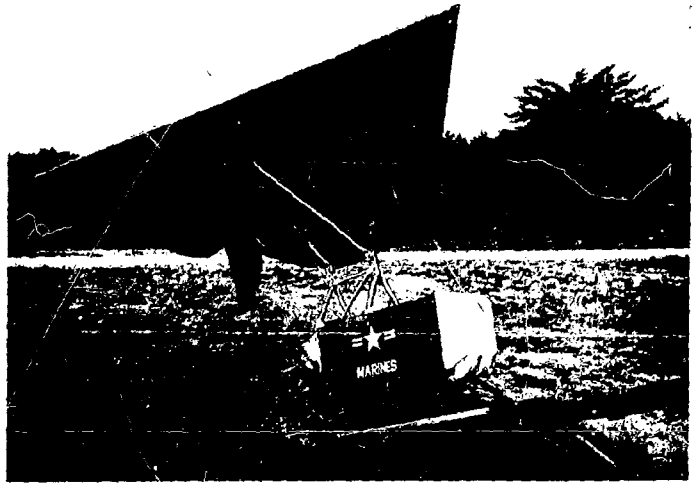
1. A comparative evaluation of the Republic "BIKINI" and Ryan "FLEX-BEE" drone systems was conducted to determine whether the Marine Corps should pursue further development in this field and, if so, to determine which of the two drone configurations will provide the better sensor platform.

2. The Republic "BIKINI" drone system is not acceptable for Marine Corps use in its present configuration, and is limited to visual control to a maximum range of 1800 meters and maximum payload of 8-10 pounds. Known major deficiencies include a lack of in-flight stability, poor obstacle clearance capability, poor rate of climb, high sensitivity to radio commands, and an unacceptable rate of decent during parachute recovery. While unknown, maintenance and training requirements may be excessive.

3. The Ryan "FLEX-BEE" drone system is not acceptable for Marine Corps use in its present configuration, and is limited to visual control to a maximum range of 1400 meters. Known major deficiencies include an unsatisfactory launcher and an unsatisfactory recovery system. While unknown, maintenance requirements may be excessive.

4. In view of the fact that "BIKINI" is in a much more advanced state of development than "FLEX-BEE", and it is felt that the major deficiencies of "BIKINI" are easier to correct than are those of "FLEX-BEE", it is recommended that further development be undertaken with Republic Aircraft Corporation for the correction of deficiencies on existing "BIKINI" drone systems and subsequent Service Test. No further development action is recommended with Ryan Aeronautical Company's "FLEX-BEE" drone system.

Republic "BIKINI" Drone System



Ryan "FLEX-BEE" Drone System

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(Project #20-63-01)

CLASSIFICATION: Unclassified

PROJECT NO: 20-63-01

SUBJECT: Lightweight Battlefield Surveillance Drones; Final Report

REFERENCES: (a) CMC Project Directive 20-63-01 of 15 January 1963

(b) CMC ltr A02-PW-hjh of 17 April 1963 to CMCLFDA

(c) CMC ltr A02-hjh of 13 December 1962

ANNEXES: A - Details of Test

B - Deficiencies and Suggested Modifications

C - Photographs

D - Supplementary Republic Flights

E - Distribution List

1. INTRODUCTION

a. Purpose - To determine whether the Marine Corps should pursue further development in this field and, if so, to determine which of the two drone configurations (Republic "BIKINI" or Ryan "FLEX-BEE") will provide the better sensor platform. An additional purpose of this project was an evaluation of the launcher and control systems.

b. Description

(1) Republic "BIKINI" drone system - The drone airframe has conventional aircraft design characteristics. It weighs about 48 pounds, has an over-all length of 74 inches and wing span of 96 inches. It is powered by a two-cycle, two cylinder, 2.7 HP gasoline engine. The drone is commanded in flight by a semi-secure radio system which actuates servos to drive the rudder, elevators, throttle, and sensor. The drone system employs a zero length, portable, catapult launcher utilizing low-pressure air in an accumulator to drive the launch piston.

(2) Ryan "FLEX-BEE" drone system - The drone airframe is designed on the flexible wing principle devised by Francis Rogallo of NASA. This drone configuration resembles a box slung under a triangular, kite-like wing. The wing consists of a lightweight, mylar-covered fabric attached to three rods, which are joined at an apex to form the triangular shape. A rectangular, box-shaped fuselage is attached to the wing by struts. A 9.5 HP, one-cylinder, gasoline engine drives a pusher propeller located at the after-end of the fuselage. The drone is commanded in flight by a semi-secure radio system which actuates proportional control servo-mechanisms. These servos move control cables to change the wing's angle of attack and to shift the center of gravity of the fuselage with respect to the wing's center of lift. In this manner the drone can be made to climb, drive, and change direction. Servos also drive the throttle and sensor controls. The drone weighs about 70 pounds and has a wing keel-length of 76 inches. The drone system employs a zero length, portable, catapult launcher utilizing a cartridge actuated drive piston for power.

(3) Both drone systems currently rely on visual guidance for control. The sensor in each drone system was the J. P. MAURER P-2 (70mm) camera, furnished by the government. Transport vehicles, also furnished by the government, were used to carry the drone and supporting equipment in the field for these tests.

c. Background

(1) During July - December 1961, the Ryan Aeronautical Company conducted feasibility flight tests under a MCLFDC contract of a candidate drone ("FLEX-BEE"). During the same period Republic Aviation Corporation conducted a feasibility study for a BLT Reconnaissance Drone under an ONR contract. This latter study resulted in a further contract to build and test fly a drone ("BIKINI"), which was accomplished early in 1962.

(2) As a follow-on to the initial flight tests of the Republic "BIKINI" drone and the Ryan "FLEX-BEE" drone, during December 1962, the Marine Corps proposed to Republic and Ryan that they participate in a comparative evaluation which could result in the selection of the airframe, launcher and radio command link combination most suitable for Marine Corps application.

(3) Reference (c) set forth preliminary information concerning the comparative evaluation program. It directed CMCLFDA to: (1) Devise a program of tests to be applied to both drone configurations, including launchers and radio command links; and, (2) form a committee to witness the tests, evaluate their results and make recommendations regarding further development in the drone program.

(4) Reference (a) set forth the objectives and details of the comparative evaluation program.

(5) Reference (b), with modification, amplified the contents of reference (a), and determined that the comparative evaluation program would be conducted at Marine Corps Schools, Quantico, Virginia, during the period 15-26 July 1963.

2. DISCUSSION

a. During the period 15-26 July 1963, only the Republic "BIKINI" was evaluated. Due to problems encountered during preliminary flight tests, Ryan requested a delay until September. The actual Ryan evaluation was conducted during the period 6-13 September 1963. Because of significant differences in weather and wind between the two periods, this cannot be considered a true side-by-side comparative evaluation. Where Republic flew in conditions of high temperature and humidity with calm wind, Ryan flew in moderate temperature and humidity conditions with relatively high winds.

b. All test flights for both contractors were conducted at R-4 Range, Marine Corps Schools, Quantico, Virginia.

c. The following are specific comments as they relate to the individual contractor:

(1) Republic "BIKINI"

(a) Republic arrived at the test site with only six complete drone assemblies, whereas the ONR contract required eight. It was determined that two drones had been destroyed in flight test crashes at the contractor's plant.

(b) Republic used a renovated house trailer for maintenance and repair at the test site throughout the entire test period. This trailer was designed to support the test flights, and contained a sophisticated array of test and maintenance equipment, power tools and spare parts. Because of the number of personnel employed and the facilities available, it was impossible to determine the number of maintenance hours required.

(c) Mr. Marsh LOANE, a controller on loan from Northrup Ventura, was used for all flights. Mr. Loane is considered to be one of the finest and most experienced drone pilots in the country. On several occasions Marine Officers flew "BIKINI" for very short periods of time. This was limited to mere movement of the control stick, with Mr. LOANE providing information about each command. It was the general consensus of opinions that this drone is very sensitive to commands and would require considerable practice before an individual could become proficient.

(d) Republic arrived at the test site in a high state of readiness for the evaluation. Personnel were fully aware of assigned duties and

responsibilities, and drones, launcher and ancillary items of flight equipment were neatly packaged for transport by jeep and trailer.

(e) During a two-week test period Republic conducted 16 successful flights. A 17th flight was attempted, but the drone crashed shortly after leaving the launcher. (See ANNEX A).

(f) During all flights in the test period it was noted that the limit for adequate visual control is approximately 1800 meters. (See ANNEX A).

(g) The Republic "BIKINI" launch system is lightweight, simple and capable of complete assembly and launch by two men in approximatly 10 minutes. It must be perfectly level, however, to insure proper launch. In its present configuration the launcher requires an external high pressure air source to fill a large and bulky pneumatic accumulator. (See ANNEX A).

(h) The drone's rate of climb after leaving the launcher is 1000 feet in five minutes and is, therefore, considered unsatisfactory. It should be capable of clearing a 100 foot obstacle in 100 meters and climbing to an altitude of 1000 feet in one minute under all environmental conditions. (See ANNEX A).

(i) The drone's stability in flight is poor and possibly unsatisfactory. During 10 of 16 flights an apparent lack of stability was observed. This was particularly noticeable when flying over wooded areas on hot, humid days. Since all observations were visual and the drone flew in relatively calm wind conditions, it was impossible to determine whether or not this instability is significant enough to degrade the drone's performance as a sensor platform (See ANNEX A).

(j) Due to the lack of stability, it is doubtful that the "BIKINI" drone could be effectively controlled beyond the controller's visability. During all flights the controller was required to "think ahead" of the drone. This would not be possible with radar tracking. For radar tracking flights it is felt that the drone would require gyro stabilization. (See ANNEX A).

(k) The rate of descent during parachute recovery of the "BIKINI" drone is unsatisfactory. During the majority of flights some damage was recorded, particularly to the tail section. (See ANNEX A).

(l) There is very little security in the present command system. By using "flash command", the present system should provide sufficient security to operate in its expected environment.

(m) The P-2 Camera in its present configuration is not suitable for use with a slow flying drone. It would be acceptable if it had a 38-40mm focal length lens for more coverage, a recycle speed of 1 frame every 5 seconds, and a lens capable of resolving 1 foot on the ground from an altitude of 2000 feet. (See ANNEX C).

(n) Based on an analysis of average fuel consumed, the maximum endurance of the "BIKINI" drone is 30 minutes, which includes 2-3 minutes of check-out time prior to launch. While this does not meet the contract requirement of 45 minutes, it is adequate for limit of visibility flights.

(o) The maximum payload of the "BIKINI" drone is approximately 8-10 pounds. While this does not meet the contract requirement of 20-30 pounds, it is sufficient for present or anticipated camera sensors.

(p) The battery life of the Republic "BIKINI" drone is approximately 30 minutes, or sufficient for one flight. To insure reliability under all conditions a small generator with a back-up battery should be used.

(q) The Republic "BIKINI" drone has a considerable audible signature during the launch phase. Although not observed, it is felt that propeller wash during pre-launch check-out would cause a noticeable visual signature in dry, dusty terrain.

(r) While not a part of this evaluation, it is felt that this drone would not be vulnerable to small arms fire from the ground. It represents a very small target at altitudes over 1000 feet, and is flying at a speed of approximately 80 miles per hour.

(2) Ryan "FLEX-BEE"

(a) Ryan arrived at the test site with components for eight complete drone assemblies. These had to be assembled under field conditions, requiring approximately 24 man-hours for each drone.

(b) Ryan used a 20 x 30 foot fabric shelter for assembly, maintenance and repair at the test site throughout the entire period. Only limited test and maintenance equipment, power tools and spare parts were available. Because of the number of personnel employed, it was impossible to determine the number of maintenance hours required.

(c) Mr. Art AKERS and Mr. Herbert KREDIET, both Ryan employees, were controllers for all flights. The majority of their experience was limited to preliminary test flights of the "FLEX-BEE". Because of this, it is felt that several of the unsuccessful flights resulted from pilot error and judgement.

(d) Ryan arrived at the test site in a fairly poor state of readiness for the evaluation. This was partially the fault of the contractor and partially the fault of the Government. Due to problems encountered in preliminary flight tests with a drone which represents a radical departure from conventional aircraft design, changes were being made in design and construction right up to the time of this evaluation. The result was that little time was spent in perfecting a smooth launch sequence and in packaging equipment for transport. Moreover, the Government could furnish only a C-117 aircraft for movement of Ryan personnel and equipment from San Diego to Quantico. Because of weight and cube limitations,

Therefore, Ryan was not afforded an opportunity to have their specially configured jeep and special test and maintenance equipment available at the test site.

(e) During the seven day test period Ryan made 15 launches. Due to various problems which were encountered, the majority of the flights were unsuccessful. The problems, however, with the exception of an unsatisfactory recovery system, appeared to be minor and capable of correction. Primarily, they were in the areas of pilot error, failures in the command system, and insufficient power supply. Concerning the latter, it was found upon conclusion of the evaluation that the battery power source was insufficient for the power drain of the P-2 camera with a 50 foot magazine. This observation is based on the fact that on several flights the drone became sluggish in response to radio commands after the camera had been activated. (See ANNEX A).

(f) During all flights in the test period it was noted that the limit of visibility for adequate control is approximately 1400 meters. It is felt, however, that the range could be extended to 1800-2000 meters by using a color contrast code on the drone which will show attitude to the controller. (See ANNEX A).

(g) The Ryan "FLEX-BEE" launch system is lightweight and, although timed for only one flight, appears capable of assembly and launch by two men in approximately 18 minutes. (See ANNEX A).

(h) The drone's rate of climb after leaving the launcher is excellent. It is capable of climbing to 1000 feet in one minute. (See ANNEX A).

(i) The drone's stability in flight is very good. Even under conditions of high winds the drone appeared to be an exceptionally stable platform. (See ANNEX A).

(j) It is doubtful that the "FLEX-BEE" drone could be effectively controlled beyond the controller's visibility. For radar tracking flights it is felt that the drone would require gyro stabilization. (See ANNEX A).

(k) The "para-glide" recovery system of the "FLEX-BEE" drone is considered unsatisfactory. (See ANNEX A)

(l) There is very little security in the command system. By using "flash command", the present system would provide sufficient security to operate in its expected environment.

(m) The P-2 camera in its present configuration is not suitable for use with a slow flying drone. It would be acceptable if it had a 38-40mm focal length lens for more coverage, a recycle speed of 1 frame every 5 seconds, and a lens capable of resolving 1 foot on the ground from an altitude of 2000 feet. (See ANNEX C).

(n) Based on an analysis of average fuel consumed, the maximum endurance of the "FLEX-BEE" drone is 45 minutes, which includes 2-3 minutes of check-out time on the ground prior to launch.

(o) While not evaluated it is felt that the maximum payload of the "FLEX-BEE" drone system is probably 20-30 pounds.

(p) The battery life of the Ryan "FLEX-BEE" drone is unsatisfactory. To provide power for the control system and camera, and to insure reliability under all conditions, a small generator with a back-up battery should be used.

(q) The Ryan "FLEX-BEE" drone has a considerable audible signature during launch. This could be corrected through the use of a small muffler.

(r) While not a part of this evaluation, it is felt that this drone would not be vulnerable to small arms fire from the ground. It represents a very small target at altitudes of over 1000 feet and is flying at a speed of 60-70 miles per hour.

3. CONCLUSIONS

a. Republic "BIKINI"

(1) That the maintenance problems associated with this drone system are unknown.

(2) That a considerable period of time may be required to adequately train a controller to effectively fly this drone.

(3) That the complete drone system, with two drones, is capable of transport by jeep and trailer or mechanical mule, and can be erected in approximately 10 minutes.

(4) That the drone can be controlled visually to a limit of 1800 meters, and that it is doubtful that it can be controlled by radar tracking.

(5) That the drone's rate of climb is unsatisfactory.

(6) That the drone's stability in flight is poor.

(7) That the drone is very sensitive to commands.

(8) That the drone's rate of descent during parachute recovery is unsatisfactory.

(9) That there is insufficient security in the radio command system.

(10) That the P-2 Camera is unacceptable in its present configuration for use with this drone.

(11) That the drone's maximum endurance time is 30 minutes.

(12) That the drone's maximum payload is 8-10 pounds.

(13) That the drone's battery power source has marginal life.

(14) That the drone has a considerable audible signature during launch and could have a visual signature in dry, dusty terrain.

(15) That if all deficiencies noted in ANNEX B were corrected, and maintenance and controller training did not create unusual problems, the Republic "BIKINI" would be an acceptable drone system for surveillance flights to a maximum effective range of 1800 meters. It is considered that the indicated deficiencies are readily correctable by the contractor through minor design modifications.

b. Ryan "FLEX-BEE"

(1) That the maintenance problems associated with this drone system are unknown.

(2) That a controller could be trained to fly this drone in an acceptable period of time.

(3) That the complete drone system, with one drone, is capable of transport by jeep or mechanical mule, and can be erected in approximately 18 minutes.

(4) That the drone can be controlled visually to a limit of 1400 meters.

(5) That the drone's rate of climb is excellent.

(6) That the drone's stability in flight is very good.

(7) That the drone's recovery system is unsatisfactory.

(8) That there is insufficient security in the radio command system.

(9) That the P-2 camera is unacceptable in its present configuration for use with this drone.

(10) That the drone's maximum endurance time is 45 minutes.

(11) That the drone's maximum probable payload is 20-30 pounds.

(12) That the drone's battery power source is unsatisfactory.

(13) That the drone has a considerable audible signature during launch and would have a visual signature in dry, dusty terrain.

(14) That if all the deficiencies noted in ANNEX B were corrected and maintenance did not create unusual problems, the Ryan "FLEX-BEE" would be an acceptable drone system for surveillance flights to a maximum effective range of 1800-2000 meters. It is considered that correction of the unsatisfactory recovery system would require major redesign and further development by the contractor.

4. RECOMMENDATIONS

a. Republic "BIKINI"

(1) In view of the fact that all deficiencies appear to be easily corrected, and this system has successfully demonstrated its capability to perform missions to the limit of controller visibility, it is recommended that the contractor be requested to correct deficiencies set forth in ANNEX B on existing drone systems.

(2) That, when it has been determined that deficiencies have been satisfactorily corrected, four Marine (two controllers and two maintenance personnel) be sent to the contractor's plant for instruction on the control and maintenance of "BIKINI". The period of instruction should be as specified by the contractor.

(3) That, upon completion of this instruction, a service test be conducted within the Fleet Marine Force for a period of six months. The purpose of this test would be to further evaluate the drone system, with particular emphasis on controller and maintenance problems, and to develop operational techniques.

(4) That the J. P. MAURER Company, be requested to modify existing P-2 cameras in accordance with the recommendations set forth in ANNEX C, for use during a service test.

b. Ryan "FLEX-BEE"

(1) While stability in flight, apparent ease of control, and obstacle clearance and climb capabilities of this system appear satisfactory, the completely unsatisfactory recovery system, which would require extensive further development to correct, and the demonstrated lack of reliability in performance of assigned missions are such that no further development is recommended with the Ryan "FLEX-BEE" drone system.

(2) However, if the contractor is willing to undertake further development to correct deficiencies noted in ANNEX B at no expense to the Government, the Marine Corps should re-evaluate "FLEX-BEE" at a future date.

ANNEX A - Details of Test

1. General

a. Concept of test

(1) The test program was conducted at Marine Corps Schools, Quantico, Virginia, during the periods 15-26 July 1963 for the Republic "BIKINI" drone system, and 6-13 September 1963 for the Ryan "FLEX-BEE" drone system.

(2) Each drone system was required to make at least fifteen successful launches and recoveries of its equipment. Maximum range required on flights was 2000 meters, with the entire flight made within sight of the controller. The sensor for both drones was the P-2 (70mm) camera. Photographs were taken of prepositioned targets or predetermined areas within a 2000 meters range. Required altitudes for flights were between 300 and 1500 feet. Drones and cameras were controlled by a semi-secure command system. Launching of the drones was accomplished from field type "zero length" launchers. Cognizance was taken of the time required to ready the equipment for launch, and a maximum time of 20 minutes, utilizing a crew of no more than two persons, was allowed. Cognizance was taken of the weight, size, simplicity, and handling ease of the items furnished. Recovery was to be within 50 meters of the launch position or designated recovery spot. Drones were not required to launch in winds exceeding 20 knots. An airborne endurance time of 45 minutes was required.

b. Test objectives

(1) The general test objectives were to comparatively evaluate:

(a) The drone system on the basis of performance for airframe stability and reliability as a sensor platform

(b) Zero-length launchers under varying wind and terrain conditions.

(c) Performance of the semi-secure radio command system.

(d) Simplicity of operation.

(e) Maintenance requirements.

(f) Suitability of each system on the basis of their ability to detect targets.

c. Method of Evaluation

The evaluation of the candidate drone systems was made by a committee appointed by the Director, MCLFDC. This committee included persons who were familiar with the expected capabilities of the Lightweight Battlefield

Surveillance Drone. A qualified imagery interpreter comparatively evaluated processed photography. The committee observed the entire flight program recorded and evaluated data collected.

2. Test No. 1 - Physical Characteristics

a. The test items were inspected, weighed, measured and photographed.

(1) Republic "BIKINI"

Drone: Length - 74 inches

Wing span - 96 inches

Weight - 48 pounds with camera and 15 foot magazine

Construction - Fiberglass

Engine - 2.7 HP, 2 cycle, 2 cylinder

Control System - Electric activators

Propeller - 18 inch diameter, 20 inch pitch

Payload compartment - 12-1/2 x 4-1/4 x 6-1/2 inches

Launcher: Length - 239 inches extended; 156 inches collapsed

Weight - 80 pounds

Construction - Aluminum

Type - Zero length pneumatic

Photographs: (See APPENDIX 3 to ANNEX C)

(2) Ryan "FLEX-BEE"

Drone: Length - Body 45 inches; Wing 76 inches

Wing span - 94 inches

Weight - 78 pounds with camera and 50 foot magazine

Construction - Tubular aluminum with aluminum skin

Engine - McCulloch MC-40, 9.5 HP, 2 cycle, 1 cylinder

Control System - Electric activators

Propeller - 26-1/2 inch pusher type

Payload compartment - 12 x 8 x 11 inches

Launcher: Length - 192 inches extended; 90 inches collapsed

Weight - 97 pounds

Construction - Steel

Type - Zero length cartridge

Photographs: (See APPENDIX 4 to ANNEX C)

3. Test No. 2 - Launching

a. Purpose

(1) To evaluate the launching procedures used with each drone system.

(2) To evaluate the visual and audible launch signatures associated with each system.

b. Method

(1) The drones were launched from different types of terrain during the test program. (See APPENDIX 2 to ANNEX C for description and location of launch sites).

(2) The procedures and time required to launch the drones were noted, recorded and evaluated with particular attention to:

(a) Special equipment required

(b) Rate of climb off launcher

(3) The visual and audible launching signatures were noted and evaluated.

c. Results

(1) Republic "BIKINI"

(a) In 17 recorded flights Republic employed a jeep and trailer which they had specially configured for drone and launcher transport. The time from arrival in the launch site to actual launch was recorded for four

flights. The average time for total set-up and launch was 10 minutes and 13 seconds. (See APPENDIX 3 for Launch Sequence).

(b) The only special tools required for normal assembly at the launch site is a "phillips" screwdriver, used to affix the empennage to the fuselage. Large, commercial type compressed air bottles were used to charge the pneumatic accumulator of the launcher.

(c) The rate of climb off the launcher is unsatisfactory. In the majority of flights, the drone dropped off to level flight for 100-300 meters after reaching the maximum trajectory provided by the launcher before it could gain altitude. Rate of climb was about 1000 feet in 5 minutes.

(d) While not observed during this test, it is felt that the air turbulence which the propeller causes for a distance of 5-10 meters behind the launcher would cause a visible signature in dry, dusty terrain.

(e) The audible signature after engine starts resembles the noise made by a power mower running at full throttle.

(f) Specific comments:

Flight No. 5 - During pre-launch check-out drone came loose from launcher when the after hold down clip slipped. Two inches of propeller broke off when it came in contact with launcher. Examination revealed that when launcher is even slightly twisted by uneven terrain the after launch shoes on drone are not engaged in launching rails. This allows drone to move from side to side, and if moved sufficiently the hold down clip will become disengaged. Propeller change took one minute and required ratchet wrench and puller.

Flight No. 8 - Drone left launcher, which was pointed slightly up hill, gained about 50 feet of altitude and settled to level flight when it reached a line of scrub trees about 70 meters from launcher. It impacted with a line of taller trees about 110 meters from launch site. The vertical angle from launch position to the tallest trees was 14^{o} 40 feet and the stadia distance 372 feet. The obstacle surveyed to 103 feet elevation.

Flight No. 10 - Soft tube causing leakage found in fuel system. Drone returned to administrative area for replacement.

(2) Ryan "FLEX-BEE"

(a) In 15 recorded flights Ryan employed a jeep which was provided by the Marine Corps at the test site. Their specially configured jeep was not transported to the test site due to space limitations aboard the aircraft provided. As a result, only one launch sequence was evaluated for time. The time for total set-up and launch was 18 minutes and 20 seconds. (See APPENDIX 4 for Launch Sequence).

(b) The only special tools required for normal assembly at the launch site are a 7/16" ratchet wrench, a 7/16" box socket and a 5 pound sledge. A small, expendable cartridge is used for launching.

(c) The rate of climb off the launcher is excellent. In the majority of flights the drone was able to gain 1000 feet in less than one minute.

(d) During one flight the air turbulence from the pusher propeller stirred considerable dust during the launch sequence. During all other flights it was noted that there was air turbulence for 10 meters to the rear of the launcher.

(e) The audible signature after engine start resembles the noise made by a chain saw engine.

(f) Specific comments:

Flight No. 1 - Drone moved forward on launcher after engine started and became disengaged. Propeller broken on contact with launcher rail. New launcher substituted. Cause later found to be front hold-down pin on drone had not been manufactured to design specifications.

Flight No. 2 - Drone had good take-off from launcher and started fast climb. Since drone has inherent tendency to climb left on take-off, controller gave right correctional command shortly after it left launcher. Drone responded to this command, but would not respond to further commands. It turned into right dive and crashed about 150 meters from launcher. Examination showed bad connection from electrical harness to drone receiver.

Flight No. 4 - Cartridge failed to ignite. Replacement used. Drone was slow off launcher and could not gain altitude. Controller flared wing and landed 100 meters from launcher. Examination showed too much friction in launcher.

Flight No. 5 - Drone started to move up launcher from 40 pound propeller thrust. Examination showed that too much friction taken out of launcher. Twine used to hold rear launcher bar in position for this and all subsequent flights.

Flight No. 7 - Cartridge failed to ignite. Replacement used. Examination showed igniter cap set too deeply in base of cartridge. Drone left launcher and settled into low level flight with slight left turn. Drone then started very steep climb at controller's command. Controller cut power to prevent possible crash of drone in administrative area.

Flight No. 11 - Drone settled to level flight for about 100 meters after leaving launcher, started steep climb to right, stalled and settled to left. Impacted with trees 200 meters distant. Examination shows cause appeared to be that launcher not giving drone sufficient flying speed.

Flight No. 13 - Cartridge failed to ignite. Replacement used.

4. Test No. 3 - Operational Suitability

a. Purpose

(1) To evaluate the drone systems' performance in flight.

b. Method

(1) The flight performance of each drone system were evaluated on the following basis:

(a) Response to radio control commands.

(b) Retention of heading and altitude both with and without correctional radio commands.

(c) Aerodynamic stability as determined by observation of flights.

(d) Maximum range at which drones can be visually observed.

(e) Flight endurance time.

c. Results

(1) Republic "BIKINI"

(a) Response to radio commands is considered very sensitive. From observations it appears to take a highly trained and skilled individual to fly this drone. It is estimated that an average of one correctional command was given at least every two seconds.

(b) The retention of heading and altitude with correctional commands is not difficult to a maximum range of 1800 meters. Beyond this range the controller has difficulty in maintaining full control at all times. While it was done for very short periods, not in excess of 20 seconds, it is not felt that this drone can retain a heading and altitude without correctional commands for any satisfactory period of time.

(c) The aerodynamic stability of this drone is considered poor. Even though the majority of flights were made in relatively calm air, the drone evidenced a marked degree of instability during 10 of the 16 actual flights. It appeared particularly unstable when flying over wooded areas on hot, humid days.

(d) The maximum range at which this drone can be effectively controlled by visual observation is 1800 meters on a clear bright day.

(e) The maximum endurance is 30 minutes, which includes launcher check-out.

(f) Specific comments:

Flight No. 7 - Engine rough during entire flight. Examination after flight showed creeping needle valve caused by low spring tension.

Flight No. 16 - Engine stopped when drone over target. Return flight of 1200 meters made with "dead stick".

(2) Ryan "FLEX-BEE"

(a) When it was clear that the drone actually received the radio command, the response was satisfactory. There were many instances, however, when it was difficult to determine whether or not non-response was due to non-receipt of the radio command or mechanical or aerodynamic control problems in the drone.

(b) The retention of heading and altitude with correctional commands is not difficult to a maximum range of 1400 meters. Beyond this range the controller has difficulty in determining attitude and heading. No attempt was made to determine whether or not this drone could retain heading and altitude without correctional commands.

(c) The aerodynamic stability of this drone is considered excellent. Even though the majority of flights were made with some air turbulence, the drone evidenced a marked degree of inherent stability. This visual observation was later confirmed when examination of exposed film showed little obliquity.

(d) The maximum range at which this drone can be effectively controlled by visual observation is 1400 meters on a clear bright day.

(e) The maximum endurance is 45 minutes, which includes launcher check-out.

(f) Specific comments:

Flight No. 1 - At about 1400 meters range the controller could not determine drone attitude and lost control. Drone crashed 1800 meters from controller.

Flight No. 3 - Flight was satisfactory until controller lost pitch control. Drone climbed on steep angle without command. Controller cut power and landed drone 300 meters to his front. Examination showed faulty drone receiver.

Flight No. 5 - Drone would not respond to right turn command when in maximum power.

Flight No. 6 - On return from target to recovery area controller could not decrease throttle. Right and left roll commands became very sluggish. Drone lost altitude and dropped into trees. Examination revealed low battery.

Flight No. 10.- Right turn appeared sluggish with full power; good with reduced power.

Flight No. 12 - Engine failure short of recovery area. No apparent cause.

Flight No. 13 - Due to high (40 knots) headwinds in return flight from target, controller had to "Tack" drone back to recovery area. In making left turn for recovery the wind caught wing and dropped drone into trees.

Flight No. 15 - Drone started to react sluggishly to commands after about 6 minutes of flight. Drone would not respond to commands after 7 minutes of flight. Drone was in spiral right hand decent and hit in trees about 1400 meters distant. Cause determined to be low battery.

5. Test No. 4 - Recovery

a. Purpose

(1) To evaluate the recovery techniques and their effect on the drones and their components, viz, airframe, control mechanism, and sensor.

(2) The recovery techniques employed by each system were noted and evaluated on the following basis:

(a) The ability to return the drone to the recovery site.

(b) The degree to which the shock of landing affects the drone airframe and its components.

c. Results

(1) Republic "BIKINI"

(a) Recovery of this drone is accomplished by controller activated parachute. In all 17 flights the parachute activated normally.

(b) In 16 planned recoveries the average distance from the designated point of recovery to the actual point of recovery was 57 meters.

(c) The following damage was recorded.

Flight No. 1 - Forward edge of vertical stabilizer dislodged from retaining shoe. Wooden fuselage separator dislodged from bottom of vertical stabilizer.

Flight No. 2 - Small cracks on fuselage approximately one foot from tail. Rudder safety wire loose.

Flight No. 3 - Horizontal stabilizer cracked from front to rear on both sides of main fuselage. Rivets pulled from fuselage stiffener on starboard parachute access door.

Flight No. 4 - Horizontal stabilizer broken on starboard side.

Flight No. 5 - Multiple fractures on fuselage about 1-2 feet from tail. Starboard parachute access door sprung in rear.

Flight No. 6 - No visible damage.

Flight No. 7 - Horizontal stabilizer cracked from front to rear on both sides of main fuselage. Small fracture just forward of camera port.

Flight No. 8 - Propeller broken. Leading edge of port wing split from tip inbound 1-1/2 feet.

Flight No. 9 - Slight fractures and delamination of the main fuselage just forward of tail.

Flight No. 10 - Front riser engaged port cylinder head during parachute deployment, causing drone to drop tail first. Main tail fuselage had severe fractures and vertical stabilizer pulled from retaining glove.

Flight No. 11 - No visible damage.

Flight No. 12 - Rivets on vertical stabilizer retaining glove pulled.

Flight No. 13 - No visible damage.

Flight No. 14 - Horizontal stabilizer cracked from front to rear on both sides of the fuselage. Vertical stabilizer pulled from retaining glove. Slight fracture just aft of camera port. Camera port dented.

Flight No. 15 - Two slight cracks on fuselage one foot from tail. Delamination for about one inch on tail.

Flight No. 16 - Vertical stabilizer pulled from retaining glove.

Flight No. 17 - Broken propeller.

(2) Ryan "FLEX-BEE

(a) Recovery is accomplished by the controller gliding the drone into the recovery site. As a result of the poor performance shown in the ability to successfully effect recovery, it is considered that this method is unsatisfactory.

(b) In 10 attempts at recovery, the average distance from the designated point of recovery to the actual point of impact was 336 meters.

(c) The following damage was recorded.

Flight No. 1 - Airframe total wreck. No visible damage to internal components.

Flight No. 2 - Airframe total wreck. Camera magazine separated from camera. Battery pack and propeller broken.

Flight No. 3 - Right landing skid broken. Wing spreader bar bent 10 inches from edge on starboard side.

Flight No. 4 - Broken propeller.

Flight No. 5 - No visible damage.

Flight No. 6 - Multiple cracks on nose cone.

Flight No. 7 - Severe damage to fuselage in forward section.

Flight No. 8 - Forward launch bar bent. Nose cone split. Port side skin sprung. Starboard side skin slightly sprung.

Flight No. 9 - Starboard leading edge bar broken.

Flight No. 10 - Airframe bent. Starboard side skin sprung. Propeller broken. Leading edge of wing broken.

Flight No. 11 - Broken propeller and port landing skid.

Flight No. 12 - Airframe bent. Nose cone broken. Starboard side skin sprung.

Flight No. 13 - Propeller broken. Nose cone split. Broken keel and spreader bar on wing.

Flight No. 14 - Nose cone split. Propeller broken. Port side skin sprung. Bent starboard skid. Bent wing keel bar. Bent engine support arm.

Flight No. 15 - Airframe total wreck. Propeller broken. Split nose cone. Bent wing spreader bar.

6. Test No. 5 - Maintenance Requirements

a. Purpose

(1) To evaluate the maintenance requirements of each drone system.

b. Method

(1) During the flight test program the relative durability and reliability of the drone systems were noted. Special attention was directed to maintenance problems and difficulties encountered in keeping the systems operable.

c. Results

(1) Republic "BIKINI" - In view of the number of maintenance personnel and the extensive and sophisticated maintenance and repair facilities which were available in the house trailer furnished by Republic, it was impossible to keep adequate records on the number of maintenance hours spent.

(2) Ryan "FLEX-BEE" - Since Ryan arrived at the test site with unassembled drone components, the majority of the maintenance time was spent in drone assembly. Ryan operated from a tent with only hand tools and limited test equipment at their disposal.

APPENDICES:

1. Republic "BIKINI" Flight Data Sheets
2. Ryan "FLEX-BEE" Flight Data Sheets
3. Republic "BIKINI" Launch Sequence
4. Ryan "FLEX-BEE" Launch Sequence

REPUBLIC FLIGHT NO. 1

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 16 July 1963
b. Visibility: Clear and bright
c. Temperature: 88°
d. Humidity: 40%
e. Drone No: 4
f. Engine No: 103
g. Camera No: 3355
h. Launcher No: 2
i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "B"
b. Launch Personnel: (1) LOANE (2) ABERNETHY
c. Controller to launch site: 10 meters
d. Time to launch: 9 minutes 15 seconds
e. Time of launch: 1145
f. Bearing of launch: 010°
g. Wind at launch site: Calm 1 knot from 303°
h. Wind at 1000 ft: 4 knots from 220° 2000 ft: 3 knots from 190°

REMARKS:

Extremely slow rate of climb for distance of 300 meters from launcher.

4. Flight Phase:

a. Target No: 9
b. Range to target: 1200 meters
c. Type target: Point
d. Bearing to target: 063°

e. Target visible to controller?: Yes

f. Maximum range flown: 1000 meters

g. Maximum altitude flown: 1000 feet

h. Photo coverage of target: 100%

REMARKS: Drone out of trim in yaw axis. Pilot parachute hit vertical tail on activation.

5. Recovery Phase:

a. Total time of flight: 2 minutes 30 seconds

b. Designated recovery point: "C"

c. Distance from designated recovery point to actual recovery point: 300 meters

d. Damage on recovery: Vertical tail dislodged from forward retaining shoe. Separation of vertical tail fuselage separator.

6. Target Observers Comments:

a. Detection of launch: Could clearly hear and see entire launch.

b. Detection of drone in flight: Could clearly hear and see entire flight.

REPUBLIC FLIGHT NO. 2

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 16 July 1963

b. Visibility: Clear, high clouds

c. Temperature: 91°

d. Humidity: 39%

e. Drone No: 6

f. Engine No: 110

g. Camera No: 0913

h. Launcher No: 1

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "A"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 15 meters

d. Time to launch: Not observed

e. Time of Launch: 1416

f. Bearing of launch: 120°

g. Wind at launch site: Calm 1 knot from 139°

h. Wind at 1000 ft: 2 knots from 165° 2000 ft: 3 knots from 200°

4. Flight Phase:

a. Target No: 9

b. Range to target: 1200 meters

c. Type target: Point

d. Bearing to target: 065°

e. Target visible to controller?: Yes

f. Maximum range flown: 1400 meters

g. Maximum altitude flown: 1500 feet

h. Photo coverage of target: 100%

REMARKS: Unstable on yaw axis

5. Recovery Phase:

a. Total time of flight: 4 minutes 45 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 25 meters

d. Damage on recovery: Small cracks on fuselage approximately 1 foot from tail. Rudder safety wire came loose.

6. Target Observers Comments:

a. Detection of launch: Could clearly hear and see entire launch.

b. Detection of drone in flight: Could clearly hear and see entire flight.

REPUBLIC FLIGHT NO. 3

1. Purpose: To determine the ability of a controller to photograph an area target which ran along a radial axis 650 - 1100 meters from the control position. The controller could not see any portion of the target.

2. General Information:

a. Date: 17 July 1963

b. Visibility: Slight haze

c. Temperature: 85°

d. Humidity: 52%

e. Drone No: 7

f. Engine No: 106

g. Camera No: 0913

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "C"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 15 meters

d. Time to launch: 9 minutes 45 seconds

e. Time of launch: 1040

f. Bearing of launch: 198°

g. Wind at launch site: Calm 1 knot from 134°

h. Wind at 1000 ft: 7 knots from 220° 2000 ft: 8 knots from 220°

4. Flight Phase:

a. Target No: 16 to 4

b. Range to target: 650 - 1100 meters

c. Type target: Area

d. Bearing to target: 035°

e. Target visible to controller?: No

f. Maximum range flown: 1400 meters

g. Maximum altitude flown: 1500 feet

h. Photo coverage of target: 66%

REMARKS: Stability very poor on yaw axis. Track over target planned for SW to NE. Track was actually made from West to East

5. Recovery Phase:

a. Total time of flight: 5 minutes 23 seconds

b. Designated recovery point: "E"

c. Distance from designated recovery point to actual recovery point: 80 meters

d. Damage on recovery: Horizontal stabilizer fractured from front to rear on both sides of main fuselage. Rivets pulled from fuselage stiffener on starboard parachute access door.

6. Target Observers Comments:

a. Detection of launch: Could not hear or see launch

b. Detection of drone in flight: Could hear and see entire flight once drone was airborne.

REPUBLIC FLIGHT NO. 4

1. Purpose: To determine the ability of a controller to position drone over point target visible from the control position and for which only range and bearing are known.

2. General Information:

a. Date: 17 July 1963

b. Visibility: Clear

c. Temperature: 95°

d. Humidity: 43%

e. Drone No: 4

f. Engine No: 103

g. Camera No: 3355

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "D"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 200 meters (Controller at "B")

d. Time to launch: Not observed

e. Time of launch: 1413

f. Bearing of launch: 176°

g. Wind at launch site: Calm 5 knots from 176°

h. Wind at 1000 ft: 11 knots from 170° 2000 ft: 10 knots from 170°

4. Flight Phase:

a. Target No: 13

b. Range to target: 1300 meters

c. Type target: Point

d. Bearing to target: 070°

e. Target visible to controller?: Yes

f. Maximum range flown: 1500 meters

g. Maximum altitude flown: 1500 feet

h. Photo coverage of target: 66%

REMARKS: Unstable on roll axis during flight. Drone flown "hands-off" for 20 seconds; fair retention of altitude and heading for this period.

5. Recovery Phase:

a. Total time of flight: 10 minutes 10 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 30 meters

d. Damage on recovery: Horizontal tail broken on starboard side

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight

REPUBLIC FLIGHT NO. 5

1. Purpose: To determine the ability of a controller to photograph an area target which ran along a radial axis 11-1500 meters from the control position. The controller could not see any portion of the target.

2. General Information:

a. Date: 18 July 1963

b. Visibility: Slight haze

c. Temperature: 85°

d. Humidity: 66%

e. Drone No: 6

f. Engine No: 110

g. Camera No: 0913

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "F"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 30 meters

d. Time to launch: 22 minutes

e. Time of launch: 1042

f. Bearing of launch: 220°

g. Wind at launch site: Calm 1-2 knots from 226°

h. Wind at 1000 ft: 12 knots from 240° 2000 ft: 12 knots from 250°

REMARKS:

Drone came loose from launcher at after hold down and tipped forward just prior to launch. Two inches of propeller broken off when it came into contact with launcher rails. Probably resulted from slight twist in launcher caused by uneven terrain.

4. Flight Phase:

a. Target No: 14-15

b. Range to target: 1100-1500 meters

c. Type target: Area

d. Bearing to target: 064°

e. Target visible to controller?: No

f. Maximum range flown: 1300

g. Maximum altitude flown: 1000

h. Photo coverage of target: 75%

REMARKS: Stability in roll and yaw very poor. Stability of flight directly influenced by type of terrain. Over wooded areas it is very poor. Flight path was 200 meters to East of target area.

5. Recovery Phase:

a. Total time of flight: 4 minutes 9 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 20 meters.

d. Damage on recovery: Multiple fractures on fuselage 1-2 feet from tail. Starboard parachute access door sprung at rear..

6. Target Obwervers Comments:

a. Detection of launch: Could hear but not see entire launch

b. Detection of drone in flight: Could hear entire flight. Not visible until it gained 400 feet altitude.

REPUBLIC FLIGHT NO. 6

1. Purpose: To determine the ability of a controller to photograph an area target which ran from right to left across his front. Planned that drone would fly to right flank of target and then fly a course along the long axis of the target area to the left flank.

2. General Information:

a. Date: 18 July 1963

b. Visibility: Clear

c. Temperature: 95°

d. Humidity: 44%

e. Drone No: 4

f. Engine No: 104

g. Camera No: 3355

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "E"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 10 meters

d. Time to launch: 9 minutes 15 seconds

e. Time of launch: 1318

f. Bearing of launch: 302°

g. Wind at launch site: Calm 2 knots from 271°

h. Wind at 1000 ft: 12 knots from 271° 2000 ft. 13 knots from 240°

REMARKS:

Drone caught in down draft over trees just after launch and had very difficult time gaining altitude.

4. Flight Phase:

a. Target No: 2-6

b. Range to target: 1300 meters

c. Type target: Area

d. Bearing to target: 036° right limit; 006° left limit

e. Target visible to controller?: No

f. Maximum range flown: 2000 meters

g. Maximum altitude flown: 1800 feet

h. Photo coverage of target: 10%

REMARKS: Drone appeared out of trim in yaw axis. The depth perception problems of the controller indicate that this technique is extremely difficult.

5. Recovery Phase:

a. Total time of flight: 7 minutes 57 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 150 meters.

d. Damage on recovery: Suspended by parachute in trees--no visible damage.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight.

REPULBIC FLIGHT NO. 7

1. Purpose: To determine the ability of a controller to photograph an area target which ran from right to left across his front. The length of the target was computed and a right and left azimuth selected which would provide overlapping coverage of the target area if the drone were flown at the prescribed altitude. Engineer tape was laid out in front of the controller for 10 meters along these azimuths. The controller flew out along the right azimuth and took photographs from the time he thought he was approaching the target area until he felt he was well passed it. He then made a return run over the target area, lining up on the left azimuth marker.

2. General Information:

a. Date: 18 July 1963

b. Visibility: Slight haze

c. Temperature: 98°

d. Humidity: 40%

e. Drone No: 3

g. Engine No: 102

g. Camera No: 3355

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "E"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1516

f. Bearing of launch: 216°

g. Wind at launch site: Calm 5 knots from 181°

h. Wind at 1000 ft: 15 knots from 240° 2000 ft: 12 knots from 250°

4. Flight Phase:

a. Target No: 2-6

b. Range to target: 1300 meters

c. Type target: Area

d. Bearing to target: 036° right flank; 006° left flank

e. Target visible to controller?: No

f. Maximum range flown: 1700 meters

g. Maximum altitude flown: 1500 feet

h. Photo coverage of target: 50%

REMARKS: Considerable instability in pitch, roll and yaw. Rough engine during entire flight from creeping needle valve. This "weaving" pattern on radial axis from controller appears to be most effective for area coverage.

5. Recovery Phase:

a. Total time of flight: 5 minutes 45 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 10 meters.

d. Damage on recovery: Horizontal stabilizer fractured on both sides of fuselage. Fracture just forward of camera port.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 8

1. Purpose: To determine whether or not drone could be successfully launched from a small clearing and climb out over 100 foot obstacle in 100 meters.

2. General Information:

a. Date: 19 July 1963

b. Visibility: Slight haze

c. Temperature: 88°

d. Humidity: 54%

e. Drone No: 4

f. Engine No: 104

g. Camera No: 2137

h. Launcher No: 2

i. Controller: Loane

3. Launch Phase:

a. Launch Position: "F"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 40 meters

d. Time to launch: Not observed

e. Time of launch: 1059

f. Bearing of launch: 005°

g. Wind at launch site: Calm 1 knot from 262°

h. Wind at 1000 ft: 21 knots from 320° 2000 ft: 25 knots from 330°

REMARKS:

Launcher was pointed slightly up hill. Drone left launcher and gained about 50 feet altitude . It dropped to level flight upon reaching line of small scrubs about 70 meters from launcher. Drone could not clear taller trees about 110 meters from launcher so controller activated parachute just prior to impact. Obstacle surveyed to be 103 feet in elevation. Vertical angle from launch position to tallest trees 14° 40' stadia distance was 372'. Drone impacted at point 40 feet from the tree tops.

4. Flight Phase:

a. Target No: Not applicable

b. Range to target: Not applicable

c. Type target: Not applicable

d. Bearing to target: Not applicable

e. Target visible to controller?: Not applicable

f. Maximum range flown: Not applicable

g. Maximum altitude flown: Not applicable

h. Photo coverage of target: Not applicable

5. Recovery Phase:

a. Total time of flight: Not applicable

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable

d. Damage on recovery: Propeller broken. Leading edge of port wing split from tip inboard 1-1/2 feet.

6. Target Observers Comments:

a. Detection of launch: Not applicable

b. Detection of drone in flight: Not applicable

REPUBLIC FLIGHT NO. 9

1. Purpose: To determine whether or not drone could be successfully launched from a small, rough clearing, and to determine the ability of a controller to photograph an area target which ran along a radial axis 11-1500 meters from the control position. The controller could not see any portion of the target. Engineer tape was laid out along a bearing to the target for 10 meters as an aid to the controller.

2. General Information:

a. Date: 19 July 1963

b. Visibility: Slight haze

c. Temperature: 93°

d. Humidity: 46%

e. Drone No: 3

f. Engine No: 102

g. Camera No: 2137

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "F"

b. Launch Personnel: (1) LOANE (2) KEITH (USMC)

c. Controller to launch site: 50 meters

d. Time to launch: Not observed

e. Time of launch: 1149

f. Bearing of launch: 241°

g. Wind at launch site: Calm 1-2 knots from 110°

h. Wind at 1000 ft: 21 knots from 320° 2000 ft: 25 knots from 330°

REMARKS:

Launcher was pointed slightly up hill. Drone left launcher and gained 40-50 feet altitude. Dropped to level flight when it flew over heavy foilage 75 meters from launch position and just missed impacting with trees. Could not gain any altitude for about 200 meters more. Vertical angle to highest trees was 6° 10' and stadia distance was 264'.

4. Flight Phase:

a. Target No: 14 to 15

b. Range to target: 1100-1500 meters

c. Type target: Area

d. Bearing to target: 064°

e. Target visible to controller?: No

f. Maximum range flown: 1500

g. Maximum altitude flown: 1200

h. Photo coverage of target: No photo record

REMARKS: Considerable instability from what appeared to be turbulent air. The drone appeared very unstable in pitch axis over target area.

5. Recovery Phase:

a. Total time of flight: 4 minutes 50 seconds

b. Designated recovery point: "B" (Designated recovery point 450 meters from controller)

c. Distance from designated recovery point to actual recovery point: 50 meters

d. Damage on recovery: Slight fractures and delamination of main fuselage just forward of the tail

6. Target Observers Comments:

a. Detection of launch: Could hear but could not see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 10

1. Purpose: To determine if a controller could photograph an area target which ran across his front at a range of 1200 meters on the right flank and 2000 meters on the left flank, using a tree line which was visible and ran the length of the target as a reference.

2. General Information

a. Date: 19 July 1963
b. Visibility: Slight haze
c. Temperature: 95°
d. Humidity: 46%
e. Drone No: 7
f. Engine No: 106
g. Camera No: 0913
h. Launcher No: 2
i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "G"
b. Launch Personnel: (1) LOANE (2) KEITH (USMC)
c. Controller to launch site: 30 meters
d. Time to launch: Not observed
e. Time of launch: 1512
f. Bearing of launch: 204°
g. Wind at launch site: Calm | 3 knots from 173°
h. Wind at 1000 ft: 7 knots from 160° 2000 ft: 5 knots from 180°

REMARKS:

Gasoline leak found in fuel pressure system. Probably from high temperatures. Launch delayed 1/2 hour while drone returned to test area for repair.

4. Flight Phase:

a. Target No: 14 to 1

b. Range to target: 1700 meters right flank; 2000 meters left flank

c. Type target: Area

d. Bearing to target: 061° right flank; 014° left flank

e. Target visible to controller?: No

f. Maximum range flown: 2300 meters

g. Maximum altitude flown: 1500 feet

h. Photo coverage of target: 30%

REMARKS: Drone very slow in gaining altitude. Took 6 minutes to 1500 feet. Controller almost aborted after launch due to climbing difficulty. Drone very unstable over wooded areas. Extremely difficult to hold stable attitude at ranges in excess of 1800 meters.

5. Recovery Phase:

a. Total time of flight: 9 minutes 30 seconds

b. Designated recovery point: "E"

c. Distance from designated recovery point to actual recovery point: 10 meters

d. Damage on recovery: Severe fractures on fuselage at tail. Vertical tail pulled from retaining glove. Front parachute riser caught on port cylinder head during deployment causing drone to land tail first.

6. Target Observers Comments:

a. Detection of launch: Could hear occasionally.

b. Detection of drone in flight: Could hear and see entire flight after drone reached 6-700 feet.

REPUBLIC FLIGHT NO. 11

1. Purpose. To examine problems in rough terrain launching. The launch site was very small and surrounded with 20-30 foot trees.

2. General Information:

a. Date: 22 July 1963

b. Visibility: Hazy

c. Temperature: 77°

d. Humidity: 71%

e. Drone No. 4

f. Engine No: 104

g. Camera No: 2137

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "H"

b. Launch Personnel: (1) LOANE (2) KEITH (USMC)

c. Controller to launch site: 60 meters

d. Time to launch: 12 minutes 40 seconds

e. Time of launch: 1104

f. Bearing of launch: 029°

g. Wind at launch site: Calm 1 knot from 048°

h. Wind at 1000 ft: 11 knots from 020° 2000 ft: 12 knots from 060°

REMARKS:

Drone left launcher and settled to level flight of about 50 feet for 2-300 meters before climbing. Just missed tree tops.

4. Flight Phase:

a. Target No: Launch sites A, B, and C

b. Range to target: 600 meters

c. Type target: Area

d. Bearing to target: 220° left flank; 235° right flank

e. Target visible to controller?: Yes

f. Maximum range flown: 1200 meters

g. Maximum altitude flown: 600 feet

h. Photo coverage of target: 10%

REMARKS: Engine was rough during flight. Later determined to be rich gasoline mixture.

5. Recovery Phase:

a. Total time of flight: 4 minutes 20 seconds

b. Designated recovery point: "F"

c. Distance from designated recovery point to actual recovery point: 75 meters

d. Damage on recovery: Rear parachute riser looped around starboard wing during deployment. Drone landed in trees. No damage.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight

REPUBLIC FLIGHT NO. 12

1. Purpose: To determine ability of controller to photograph an area target which ran along a radial axis 650-1100 meters from the control position. Engineer tape was laid out along the bearing to the target as an aid to the controller.

2. General Information:

a. Date: 22 July 1963

b. Visibility: Slight haze

c. Temperature: 81°

d. Humidity: 57%

e. Drone No: 6

f. Engine No: 110

g. Camera No: 2137

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "A"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 200 meters

d. Time to launch: Not observed

e. Time of launch: 1300

f. Bearing of launch: 067°

g. Wind at launch site: Calm 2-3 knots from 033°

h. Wind at 1000 ft: 11 knots from 020° 2000 ft: 12 knots from 060°

4. Flight Phase:

a. Target No: 16 to 4

b. Range to target: 650 - 1100 meters

c. Type target: Area

d. Bearing to target: 031°

e. Target visible to controller?: No

f. Maximum range flown: 1700 meters

g. Maximum altitude flown: 1500 feet

h. Photo coverage of target: 60%

REMARKS: Drone appeared very unstable in flight. Controller had difficulty in maintaining proper heading and altitude.

5. Recovery Phase:

a. Total time of flight: 6 minutes 5 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 30 meters

d. Damage on recovery: Rear rivets pulled on vertical tail retaining shoe.

6. Target Observers Comments:

a. Detection of launch: Could not detect.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 13

1. Purpose: To photograph an entire 1000 meter grid square. An altitude of 2500 feet was pre-programmed, as this would provide an area coverage of 550 x 550 meters for each frame. Bearings were taken on points 250 meters in from the right flank and 250 meters in from the left flank. Engineer tape was laid out from the controller along these bearings. After gaining altitude the controller was to fly along the right bearing marker and photograph the right one-half of the target, then reverse course and fly back along the left bearing marker to photograph the left one-half of the target.

2. General Information:

a. Date: 22 July 1963

b. Visibility: Slight haze

c. Temperature: 82°

d. Humidity: 51%

e. Drone No: 5

f. Engine No: 107

g. Camera No: 2137

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "G"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 40 meters

d. Time to launch: Not observed

e. Time of launch: 1531

f. Bearing of launch: 078°

g. Wind at launch site: Calm 0-1 knot from 099°

h. Wind at 1000 ft: 11 knots from 060° 2000 ft: 7 knots from 070°

4. Flight Phase:

a. Target No: Grid square 0111

b. Range to target: 925-1925 meters

c. Type target: Area

d. Bearing to target: 034° left flank; 052° right flank

e. Target visible to controller?: No

f. Maximum range flown: 1800 meters

g. Maximum altitude flown: 2500 feet

h. Photo coverage of target: Jammed magazine

REMARKS: Drone appeared to be right wing heavy in flight.

5. Recovery Phase:

a. Total time of flight: 9 minutes 15 seconds

b. Designated recovery point: "E"

c. Distance from designated recovery point to actual recovery point: 10 meters

d. Damage on recovery: No visible damage

6. Target Observers Comments:

a. Detection of launch: Could not detect launch.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 14

1. Purpose: To determine ability of a controller to photograph an area target which ran across his front. An altitude of 1000 feet was pre-programmed as this would provide a coverage of 250 x 250 meters on each frame. A bearing was taken 175 meters in from the right flank and another 175 meters in from the left flank. Engineer tape was laid out from the controller along these bearings. After gaining altitude the controller was to fly along the right bearing marker and photograph the right one-half of the target area, then reverse course and fly back along the left bearing marker to photograph the left one-half of the target area.

2. General Information:

a. Date: 24 July 1963

b. Visibility: Haze overcast

c. Temperature: 80°

d. Humidity: 64%

e. Drone No: 4

f. Engine No: 104

g. Camera No: 3047

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "B"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 5 meters

d. Time to launch: Not observed

e. Time of launch: 0941

f. Bearing of launch 010°

g. Wind at launch site: Calm 0-1 knot from 276°

h. Wind at 1000 ft: 4 knots from 320° 2000 ft: 5 knots from 330°

4. Flight Phase:

a. Target No: 5 to 7

b. Range to target: 1200 meters

c. Type target: Area

d. Bearing to target: 063° right flank; 043° left flank

e. Target visible to controller?: One-half

f. Maximum range flown: 1100 meters

g. Maximum altitude flown: 1000 feet

h. Photo coverage of target: 10%

5. Recovery Phase:

a. Total time of flight: 3 minutes 33 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 10 meters

d. Damage on recovery: Horizontal tail broken both sides of fuselage. Vertical tail pulled from retaining glove. Slight fracture just aft of camera port. Camera port dented.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 15

1. Purpose: To determine ability of a controller to photograph an area target which ran across his front. An altitude of 600 feet was pre-programmed as this would provide a coverage of 150x150 meters on each frame. A bearing was taken 75 meters in from the right flank and another 75 meters in from the left flank. Engineer tape was laid out from the controller along these bearings. After gaining altitude the controller was to fly along the right bearing marker and photograph the right one half of the target area, then reverse course and fly back along the left bearing marker to photograph the left one half of the target area.

2. General Information:

a. Date: 24 July 1963
b. Visibility: Slight haze
c. Temperature: 82°
d. Humidity: 55%
e. Drone No: 6
f. Engine No: 0587
g. Camera No: 2137
h. Launcher No: 2
i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "H"
b. Launch Personnel: (1) LOANE (2) ABERNETHY
c. Controller to launch site: 30 meters
d. Time to launch: Not observed
e. Time of launch: 1015
f. Bearing of launch: 219°
g. Wind at launch site: Calm 0-1 knot from 276°
h. Wind at 1000 ft: 4 knots from 320° 2000 ft: 5 knots from 330°

4. Flight Phase:

a. Target No: Launch sites A, B and C

b. Range to target: 600 meters

c. Type target: Area

d. Bearing to target: 239° right flank; 217° left flank

e. Target visible to controller?: Yes

f. Maximum range flown: 800 meters

g. Maximum altitude flown: 500 feet

h. Photo coverage of target: Exposure set incorrectly--no photos

5. Recovery Phase:

a. Total time of flight: 2 minutes 5 seconds

b. Designated recovery point: "F"

c. Distance from designated recovery point to actual recovery point: 10 meters

d. Damage on recovery: Two slight cracks on fuselage 1 foot from tail. Delamination for 1 inch on tail.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 16

1. Purpose: To determine ability of a controller to photograph an area target which ran across his front. An altitude of 1000 feet was pre-programmed as this would provide a coverage of 250x250 meters on each frame. A bearing was taken 175 meters in from the right flank and another 175 meters in from the left flank. Engineer tape was laid out from the controller along these bearings. After gaining altitude the controller was to fly along the right bearing marker and photograph the right one-half of the target area, then reverse course and fly back along the left bearing marker to photograph the left one-half of the target area.

2. General Information:

a. Date: 25 July 1963

b. Visibility: Haze overcast

c. Temperature: 83°

d. Humidity: 61%

e. Drone No: 4

f. Engine No: 104

g. Camera No: 2137

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "B"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 5 meters

d. Time to launch: Not observed

e. Time of launch: 1036

f. Bearing of launch: 010°

g. Wind at launch site: Calm 0-1 knot from 136°

h. Wind at 1000 ft: 13 knots from 255° 2000 ft: 8 knots from 223°

4. Flight Phase:

a. Target No: 5-7

b. Range to target: 1200 meters

c. Type target: Area

d. Bearing to target: 063° right flank; 043° left flank

e. Target visible to controller?: One half

f. Maximum range flown: 1200 meters

g. Maximum altitude flown: 800 feet

h. Photo coverage of target: No photos taken.

REMARKS: Engine stopped while drone was over target. Controller made "dead stick" return of 1200 meters.

5. Recovery Phase:

a. Total time of flight: 4 minutes 20 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 100 meters

d. Damage on recovery: Vertical tail pulled from retaining shoe.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC FLIGHT NO. 17

1. Purpose: To determine ability of a controller to photograph an area target which ran across his front. An altitude of 600 feet was pre-programmed as this would provide a coverage of 150x150 meters on each frame. A bearing was taken 75 meters in from the right flank and another 75 meters in from the left flank. Engineer tape was laid out from the controller along these bearings. After gaining altitude the controller was to fly along the right bearing marker and photograph the right one-half of the target area, then reverse course and fly back along the left bearing marker to photograph the left one-half of the target area.

2. General Information:

a. Date: 25 July 1963

b. Visibility: Haze overcast

c. Temperature: 86°

d. Humidity: 48%

e. Drone No: 3

f. Engine No: 102

g. Camera No: 2137

h. Launcher No: 2

i. Controller: LOANE

3. Launch Phase:

a. Launch Position: "H"

b. Launch Personnel: (1) LOANE (2) ABERNETHY

c. Controller to launch site: 30 meters

d. Time to launch: Not observed

e. Time of launch: 1117

f. Bearing of launch: 219°

g. Wind at launch site: Calm 0-1 knot from 200°

h. Wind at 1000 ft: 13 knots from 255° 2000 ft: 8 knots from 233°

4. Flight Phase:

   a. Target No: Launch sites A, B and C

   b. Range to target: 600 meters

   c. Type target: Area

   d. Bearing to target: 239° right flank; 217° left flank

   e. Target visible to controller?: Yes

   f. Maximum range flown: 800 meters

   g. Maximum altitude flown: 600 feet

   h. Photo coverage of target: No photo record.

5. Recovery Phase:

   a. Total time of flight: 3 minutes 29 seconds

   b. Designated recovery point: "F"

   c. Distance from designated recovery point to actual recovery point: 10 meters.

   d. Damage on recovery: Broken propeller

6. Target Observers Comments:

   a. Detection of launch: Could hear and see entire launch

   b. Detection of drone in flight: Could hear and see entire flight.

RYAN FLIGHT NO. 1

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 6 September 1963

b. Visibility: Clear

c. Temperature: 67°

d. Humidity: 61%

e. Drone No: 2

f. Engine No: 2

g. Camera No: 2

h. Launcher No: 2 (changed to 1)

i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "B"

b. Launch Personnel: (1) AKERS (2) KREDIET

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1226

f. Bearing of launch: 350°

g. Wind at launch site: Steady at 5 knots from 355°

h. Wind at 1000 ft: 17 knots from 010° 2000 ft: 20 knots from 030°

REMARKS:

Drone crept forward on launcher after engine start and became disengaged. Propeller broken on contact with launcher rail and drone fell off launcher. Contractors examination of drone and launcher found that the drone forward launcher pick-up point had not been made to design specifications. Where it should have been 9/16" in diameter, it was made 1/2" in diameter. This allowed drone to ride forward and become disengaged. Local modification made by wrapping .016 thickness wire around pin to give it desired diameter.

4. Flight Phase:

a. Target: No: 9

b. Range to target: 1200 meters

c. Type target: Point

d. Bearing to target: 063°

e. Target visible to controller?: Yes

f. Maximum range flown: 1800 meters

g. Maximum altitude flown: 1000 feet

h. Photo coverage of target: 100%

REMARKS: Drone had very high rate of climb. At a range of 1400 meters controller could not determine attitude of drone and lost control. Drone crashed in field 1800 meters from control position.

5. Recovery Phase:

a. Total time of flight: 2 minutes 38 seconds

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable

d. Damage on recovery: Total wreck of airframe. No internal damage to [illegible] parts.

6. Range Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight

RYAN FLIGHT NO. 2

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position. Contractor painted top of flex-wing white in attempt to assist controller in attitude determination; this was not used on any subsequent flights.

2. General Information:

   a. Date: 7 September 1963
   b. Visibility: Slight haze
   c. Temperature: 68°
   d. Humidity: 85%
   e. Drone No: 3
   f. Engine No: 3
   g. Camera No: 3
   h. Launcher No: 2
   i. Controller: KREDIET

3. Launch Phase:

   a. Launch Position: "B"
   b. Launch Personnel: (1) KREDIET (2) AKERS
   c. Controller to launch site: 5 meters
   d. Time to launch: Not observed
   e. Time of launch: 0957
   f. Bearing of launch: 025°
   g. Wind at launch site: Calm 0-1 knot from 340°
   h. Wind at 1000 ft: 8 knots from 140° 2000 ft: 6 knots from 207°

4. Flight Phase:

   a. Target No: 9
   b. Range to target: 1200 meters
   c. Type target: Point
   d. Bearing to target: 063°

e. Target visible to controller?: Yes

f. Maximum range flown: Not applicable

g. Maximum altitude flown: Not applicable

h. Photo coverage of target: Not applicable

REMARKS: After launch drone started rapid climb. Since it has inherent tendency to climb left on take-off, controller gave right command immediately after launch. Drone took this command but did not respond to further commands. It turned into sharp right dive about 150 meters from launcher and crashed. Examination showed bad connection from drone electrical harness to Babcock receiving unit.

5. Recovery Phase:

a. Total time of flight: Not applicable

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable

d. Damage on recovery: Total wreck of airframe. Battery pack broken. Propeller broken. Camera magazine separated from camera.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Not applicable

RYAN FLIGHT NO. 3

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

   a. Date: 7 September 1963
   b. Visibility: Slight haze
   c. Temperature: 78°
   d. Humidity: 53%
   e. Drone No: 5
   f. Engine No: 4
   g. Camera No: 5
   h. Launcher No: 2
   i. Controller: AKERS

3. Launch Phase:

   a. Launch Position: "B"
   b. Launch Personnel: (1) AKERS (2) KREDIET
   c. Controller to launch site: 10 meters
   d. Time to launch: Not observed
   e. Time of launch: 1530
   f. Bearing of launch: 029°
   g. Wind at launch site: Calm 0-1 knot from 170°
   h. Wind at 1000 ft: 8 knots from 140° 2000 ft: 6 knots from 207°

REMARKS

Launch test sequence showed pitch as well as roll being commanded by neutral button; only roll should be effected. Inspection and test could not duplicate this situation.

4. Flight Phase:

a. Target No: 9

b. Range to target: 1200 meters

c. Type target: Point

d. Bearing to target: 063°

e. Target visible to controller?: Yes

f. Maximum range flown: 1000 meters

g. Maximum altitude flown: 1000 feet

h. Photo coverage of target: Camera shutter frozen. No exposed film.

REMARKS: Very high rate of climb. Drone was going satisfactorily until drone started steep climb without command. Controller cut power and landed 300 meters to his front. Examination showed same problem with neutral button as in launch sequence. Trouble finally isolated to bad Babcock receiver.

5. Recovery Phase:

a. Total time of flight: 5 minutes 10 seconds

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable.

d. Damage on recovery: Broken right landing skid. Bent wing spreader bar.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

RYAN FLIGHT NO. 4

1. Purpose: To determine the ability of a controller to photograph an area target which ran along a radial axis 650-1100 meters from the control position. The controller could not see any portion of the target. Drone nose cone painted white for this and all subsequent flights to assist controller in attitude determination. White engineer tape used as aid to controller for bearing to target.

2. General Information:

a. Date: 9 September 1963
b. Visibility: Haze overcast
c. Temperature: 78°
d. Humidity: 61%
e. Drone No: 5
f. Engine No: 4
g. Camera No: 4
h. Launcher No: 2
i. Controller: KREDIET

3. Launch Phase:

a. Launch Position: "C"
b. Launch Personnel: (1) KREDIET (2) AKERS
c. Controller to launch site: 10 meters
d. Time to launch: Not observed
e. Time of launch: 0950
f. Bearing of launch: 042°
g. Wind at launch site: Calm 0-1 knot from 220°
h. Wind at 1000 ft: 9 knots from 250° 2000 ft: 9 knots from 230°

REMARKS:

Cartridge failed to ignite for launch. Replacement cartridge used.

4. Flight Phase:

a. Target No: 16-4

b. Range to target: 650-1100 meters

c. Type target: Area

d. Bearing to target: 035°

e. Target visible to controller?: No

f. Maximum range flown: Not applicable

g. Maximum altitude flown: Not applicable

h. Photo coverage of target: Not applicable

REMARKS: Drone appeared slow off launcher, could not gain altitude. Controller flared wing and landed drone about 100 meters from launch position. Difficulty found to be too much friction in launcher.

5. Recovery Phase:

a. Total time of flight: Not applicable

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable

d. Damage on recovery: Broken propeller

6. Target Obaervers Comments:

a. Detection of launch: Not applicable

b. Detection of drone in flight: Not applicable

RYAN FLIGHT NO. 5

1. Purpose: To determine the ability of a controller to photograph an area target which ran along a radial axis 650-1100 meters from the control position. The controller could not see any portion of the target.

2. General Information:

a. Date: 9 September 1963

b. Visibility: Slight haze

c. Temperature: 81°

d. Humidity: 57%

e. Drone No: 5

f. Engine No: 4

g. Camera No: 5

h. Launcher No: 1

i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "C"

b. Launch Personnel: (1) AKERS (2) KREDIET

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1208

f. Bearing of launch: 015°

g. Wind at launch site: Calm 1-2 knots from 330°

h. Wind at 1000 ft: 9 knots from 250° 2000 ft: 9 knots from 230°

REMARKS:

After engine start drone started to creep up launcher from propeller thrust. Contractor removed too much friction noted in Flight No. 4. Twine used to hold drone in position prior to launch.

4. Flight Phase:

a. Target No: 16-4

b. Range to Target: 650 - 1100 meters

c. Type target: Area

d. Bearing to target: 035°

e. Target visible to controller?: No

f. Maximum range flown: 2100 meters

g. Maximum altitude flown: 1200 feet

h. Photo coverage of target: None

REMARKS: Controller could not command right turn with full throttle. Drone attitude difficult to see at ranges beyond 1500 meters. Controller miscalculated approach angle for recovery, drone lost too much altitude and hit tree tops 200 meters from recovery point.

5. Recovery Phase:

a. Total time of flight: 7 minutes 20 seconds

b. Designated recovery point: "C"

c. Distance from designated recovery point to actual recovery point: 200 meters

d. Damage on recovery: None

6. Target Observers Comments:

a. Detection of launch: Could hear entire launch

b. Detection of drone in flight: Could hear and see entire flight

RYAN FLIGHT NO. 6

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 9 September 1963

b. Visibility: Slight haze

c. Temperature: 84°

d. Humidity: 54%

e. Drone No: 4

f. Engine No: 4

g. Camera No: 4

h. Launcher No: 1

i. Controller: KREDIET

3. Launch Phase:

a. Launch Position: "A"

b. Launch Personnel: (1) KREDIET (2) AKERS

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1520

f. Bearing of launch: 068°

g. Wind at launch site: Calm 0-1 knot from 005°

h. Wind at 1000 ft: 25 knots from 330° 2000 ft: 25 knots from 340°

4. Flight Phase:

a. Target No: 13

b. Range to target: 1400 meters

c. Type target: Point

d. Bearing to target: 065°

e. Target visible to controller?: Yes

f. Maximum range flown: 1200 meters

g. Maximum altitude flown: 1500 meters

h. Photo coverage of target: None

REMARKS: Excellent rate of climb. On return from target area drone throttle decrease command did not function properly and roll commands became very sluggish. Drone started to lose altitude and controller applied full power. It appeared that drone did not respond to this command and it dropped into trees 700 meters from recovery point. Examination showed bad battery pack.

5. Recovery Phase:

a. Total time of flight: 8 minutes 35 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 700 meters

d. Damage on recovery: Multiple cracks on nose cone.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight

RYAN FLIGHT NO. 7

1. Purpose: To determine the ability of a controller to photograph an area target which ran from right to left across his front. The length of the target was computed and a right and left azimuth selected which would provide overlapping coverage of the target area if the drone were flown at the prescribed altitude. Engineer tape was laid out for 10 meters in front of the controller along these azimuths. The controller was to fly the drone along the right azimuth and take photographs from the time he thought he was approaching the target area until he felt he was well passed it. He was to then make a return run over the target area, lining up on the left azimuth marker.

2. General Information:

a. Date: 10 September 1963

b. Visibility: Haze overcast

c. Temperature: 78°

d. Humidity: 50%

e. Drone No: 5

f. Engine No: 4

g. Camera No: P-220 (wide angle)

h. Launcher No: 1

i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "C"

b. Launch Personnel: (1) AKERS (2) KREDIET

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1117

f. Bearing of launch: 004°

g. Wind at launch site: Steady 20 knots from 350°

h. Wind at 1000 ft: 25 knots from 330° 2000 ft: 25 knots from 340°

REMARKS:

Cartridge failed to ignite. Replacement cartridge used for launch. Examination of bad cartridge showed cap had been set too deep in base.

4. Flight Phase:

a. Target No: 7 to 9

b. Range to target: 1200 meters

c. Type target: Area

d. Bearing to target: 061° right flank; 045° left flank

e. Target visible to controller?: No

f. Maximum range flown: Not applicable

g. Maximum altitude flown: Not applicable

h. Photo coverage of target: Not applicable

REMARKS: After leaving launcher, drone settled into low level flight with very slight left turn. Controller could not get drone to gain altitude initially, but it started very rapid climb just as it approached administrative test area. Rather than chance injury to personnel, controller cut power.

5. Recovery Phase:

a. Total time of flight: Not applicable

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable

d. Damage on recovery: Severe damage to forward section of fuselage. Propeller broken. Camera magazine separated from camera.

6. Target Observers Comments:

a. Detection of launch: Not applicable

b. Detection of drone in flight: Not applicable

RYAN FLIGHT NO. 8

1. Purpose: To determine the ability of a controller to photograph an area target which ran from right to left across his front. The length of the target was computed and a right and left azimuth selected which would provide overlapping coverage of the target area if the drone were flown at the prescribed altitude. Engineer tape was laid out for 10 meters in front of the controller along these azimuths. The controller was to fly the drone along the right azimuth and take photographs from the time he thought he was approaching the target area until he felt he was well passed it. He was to then make a return run over the target area, lining up on the left azimuth marker.

2. General Information:

a. Date: 10 September 1963

b. Visibility: Slight haze

c. Temperature: 82°

d. Humidity: 48%

e. Drone No: 7

f. Engine No: 4

g. Camera No: 1

h. Launcher No. 1

i. Controller: KREDIET

3. Launch Phase:

a. Launch Position: "C"

b. Launch Personnel: (1) KREDIET (2) AKERS

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1437

f. Bearing of launch: 007°

g. Wind at launch site: Steady 8-10 knots from 345°

h. Wind at 1000 ft: 10 knots from 350° 2000 ft: 11 knots from 340°

4. Flight Phase:

a. Target No: 7 to 9

b. Range to target: 1200 meters

c. Type target: Area

d. Bearing to target: 061° right flank; 045° left flank

e. Target visible to controller?: No

f. Maximum range flown: 600 meters

g. Maximum altitude flown: 1000 feet

h. Photo coverage of target: None

REMARKS: Outstanding stability in flight. Controller miscalculated angle of approach for recovery and cut power too soon.

5. Recovery Phase

a. Total time of flight: 2 minutes 30 seconds

b. Designated recovery point: "E"

c. Distance from designated recovery point to actual recovery point: 150 meters

d. Damage on recovery: Bent forward launch bar. Split nose cone. Slight bend in starboard fuselage skin.

6. Target Observers Comments:

a. Detection of launch: Could hear entire launch

b. Detection of drone in flight: Could hear and see entire flight

RYAN FLIGHT NO. 9

1. Purpose: To determine the ability of a controller to photograph an area target which ran from right to left across his front. The length of the target was computed and a right and left azimuth selected which would provide overlapping coverage of the target area if the drone were flown at the prescribed altitude. Engineer tape was laid out for 10 meters in front of the controller along these azimuths. The controller was to fly the drone along the right azimuth and take photographs from the time he thought he was approaching the target area until he felt he was well passed it. He was to then make a return run over the target area, lining up on the left azimuth marker.

2. General Information:

a. Date: 11 September 1963
b. Visibility: Clear
c. Temperature: 70°
d. Humidity: 59%
e. Drone No.: 4
f. Engine No: 1
g. Camera No: 4
h. Launcher No.: 1
i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "C"
b. Launch Personnel: (1) AKERS (2) KREDIET
c. Controller to launch site: 10 meters
d. Time to launch: 18 minutes 20 seconds
e. Time of launch: 1103
f. Bearing of launch: 063°
g. Wind at launch site: Calm 4-5 knots from 160°
h. Wind at 1000 ft: 6 knots from 120° 2000 ft: 9 knots from 150°

4. Flight Phase:

a. Target No: 7 to 9

b. Range to target: 1200 meters

c. Type target: Area

d. Bearing to target: 061° right flank; 045° left flank

e. Target visible to controller?: No

f. Maximum range flown: 1300 meters

g. Maximum altitude flown: 800 feet

h. Photo coverage of target: 66%

REMARKS: Drone appeared exceptionally stable in flight.

5. Recovery Phase:

a. Total time of flight: 6 minutes 45 seconds

b. Designated recovery point: "E"

c. Distance from designated recovery point to actual recovery point: 10 meters

d. Damage on recovery: Wing starboard leading edge bar broken 18" from rear.

6. Target Observers Comments:

a. Detection of launch: Could clearly hear entire launch

b. Detection of drone in flight: Could clearly see entire flight. Drone difficult to hear in flight when flying on low throttle.

RYAN FLIGHT NO. 10

1. Purpose: To determine the ability of a controller to photograph an area target which ran along a radial axis 1350-1850 meters from the control position. The controller could not see any portion of the target.

2. General Information:

a. Date: 11 September 1963

b. Visibility: Slight haze

c. Temperature: 84°

d. Humidity: 43%

e. Drone No: 6

g. Engine No: 5

g. Camera No: 1

h. Launcher No: 1

i. Controller: KREDIET

3. Launch Phase:

a. Launch Position: "B"

b. Launch Personnel: (1) KREDIET (2) AKERS

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1440

f. Bearing of launch: 148°

g. Wind at launch site: Gusty 2-7 knots from 175°

h. Wind at 1000 ft: 6 knots from 120° 2000 ft: 9 knots from 150°

REMARKS:

Excellent rate of climb off the launcher. Gained 500 feet altitude in 30 seconds and 1000 feet in 1 minute.

APPENDIX 2 to
ANNEX A

4. Flight Phase:

a. Target No: 2-1

b. Range to target: 1350-1850 meters

c. Type target: Area

d. Bearing to target: 014°

e. Target visible to controller?: No

f. Maximum range flown: 1100 meters

g. Maximum altitude flown: 1200 feet

h. Photo coverage of target: None

REMARKS: Right turn sluggish with full power on run back from target area; appeared good with reduced power. When making approach for recovery controller thought he had no right turn. In reality he had right turn, but misjudged direction of flight. Drone turned right and crashed into trees 375 meters from control position.

5. Recovery Phase:

a. Total time of flight: 6 minutes 10 seconds

b. Designated recovery point: "E"

c. Distance from designated recovery point to actual recovery point: 375 meters.

d. Damage on recovery: Bent airframe. Bend in starboard fuselage skin. Broken propeller. Broken leading edge of port wing.

6. Target Observers Comments:

a. Detection of launch: Could clearly hear entire launch.

b. Detection of drone in flight: Could clearly hear and see entire flight.

RYAN FLIGHT NO. 11

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 11 September 1963

b. Visibility: Slight haze

c. Temperature: 86°

d. Humidity: 81%

e. Drone No: 7

f. Engine No: 2

g. Camera No: 2

h. Launcher No: 1

i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "B"

b. Launch Personnel: (1) AKERS (2) KREDIET

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1635

f. Bearing of launch: 154°

g. Wind at launch site: Calm 2 knots from 176°

h. Wind at 1000 ft: 6 knots from 120° 2000 ft: 9 knots from 150°

REMARKS:

Drone left launcher slowly, settled and continued level flight for about 75 meters. Engine stalled, drone settled to left and impacted with trees 200 meters distant.

4. Flight Phase:

a. Target No: Not applicable

b. Range to target: Not applicable

c. Type target: Not applicable

d. Bearing to target: Not applicable

e. Target visible to controller?: Not applicable

f. Maximum range flown: Not applicable

g. Maximum altitude flown: Not applicable

h. Photo coverage of target: Not applicable

5. Recovery Phase:

a. Total time of flight: Not applicable

b. Designated recovery point: Not applicable

c. Distance from designated recovery point to actual recovery point: Not applicable.

d. Damage on recovery: Broken propeller and port landing skid.

6. Target Observers Comments:

a. Detection of launch: Not applicable

b. Detection of drone in flight: Not applicable

RYAN FLIGHT NO. 12

1. Purpose: To determine the ability of a controller to photograph an area target which ran along in radical axis 1200-1350 meters from control position. The controller could not see any portion of the target.

2. General Information:

a. Date: 12 September 1963

b. Visibility: Haze

c. Temperature: 81°

d. Humidity: 64%

e. Drone No: 7

f. Engine No: 2

g. Camera No: 2

h. Launcher No: 1

i. Controller: KREDIET

3. Launch Phase:

a. Launch Position: "A"

b. Launch Personnel: (1) KREDIET (2) AKERS

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1104

f. Bearing of launch: 174°

g. Wind at launch site: Gusty 6-12 knots from 195°

h. Wind at 1000 ft: 36 knots from 210° 2000 ft: 43 knots from 220°

REMARKS:

Wing rolled left without command during pre-launch check-out. On further examination this situation did not repeat itself.

4. Flight Phase:

a. Target No: 5-6

b. Range to target: 1200-1325 meters

c. Type target: Area

d. Bearing to target: 047°

e. Target visible to controller?: No

f. Maximum range flown: 1100 meters

g. Maximum altitude flown: 1200 feet

h. Photo coverage of target: Jammed magazine--no photos

REMARKS: Gusty winds caused instability for 100 meters after launch, but drone became very stable after gaining 100 feet of altitude. Project officer directed controller to return drone for recovery before it reached the target area. Engine stopped short of recovery area.

5. Recovery Phase:

a. Total time of flight: 8 minutes 25 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 200 meters.

d. Damage on recovery: Bent airframe. Broken nose cone. Starboard skin bent.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch.

b. Detection of drone in flight: Could hear and see entire flight.

RYAN FLIGHT NO. 13

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 12 September 1963

b. Visibility: Haze overcast

c. Temperature: 91°

d. Humidity: 49%

e. Drone No: 4

f. Engine No: 1

g. Camera No: 4

h. Launcher No: 1

i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "D"

b. Launch Personnel: (1) AKERS (2) KREDIET

c. Controller to launch site: 10 meters

d. Time to launch: Not observed

e. Time of launch: 1501

f. Bearing of launch: 210°

g. Wind at launch site: Gusty 10-18 knots from 195°

h. Wind at 1000 ft: 40 knots from 220° 2000 ft: 45 knots from 210°

REMARKS:

Cartridge failed to ignite. Replacement cartridge used.

4. Flight Phase:

a. Target No: 13

b. Range to target: 1300 meters

c. Type target: Point

d. Bearing to target: 071°

e. Target visible to controller?: Yes

f. Maximum range flown: 1500 meters

g. Maximum altitude flown: 2000 feet

h. Photo coverage of target: None

REMARKS: Wind gusts made drone wobbly just after launch. Very stable in flight, even with high winds. Very slow return from target area due to strong winds. Strong wind gusts caught wing while drone was in left turn at low altitude and drone crushed in trees 300 meters short of the recovery point.

5. Recovery Phase:

a. Total time of flight: 5 minutes 44 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 300 meters

d. Damage on recovery: Broken propeller. Broken wing keel and spreader bars. Split nose cone

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight

RYAN FLIGHT NO. 14

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

   a. Date: 13 September 1963
   b. Visibility: Dull
   c. Temperature: 64°
   d. Humidity: 56%
   e. Drone No: 6
   f. Engine No: 5
   g. Camera No: P220 (wide angle)
   h. Launcher No: 1
   i. Controller: AKERS

3. Launch Phase:

   a. Launch Position: "B"
   b. Launch Personnel: (1) AKERS (2) KREDIET
   c. Controller to launch site: 10 meters
   d. Time to launch: Not observed
   e. Time of launch: 1539
   f. Bearing of launch: 029°
   g. Wind at launch site: Gusty 12-15 knots from 020°
   h. Wind at 1000 ft: 18 knots from 360° 2000 ft: 15 knots from 010°

4. Flight Phase:

   a. Target No: 13
   b. Range to target: 1400 meters
   c. Type target: Point
   d. Bearing to target: 063°

e. Target visible to controller?: Yes

f. Maximum range flown: 1600 meters

g. Maximum altitude flown: 1000 feet

h. Photo coverage of target: 100%

REMARKS: Excellent rate of climb and stability in flight. Control stick broke when controller was approaching recovery point. Drone hit tree top and dropped onto roadway.

5. Recovery Phase:

a. Total time of flight: 3 minutes 55 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 125 meters

d. Damage on recovery: Broken propeller. Split nose cone. Port fuselage skin bent. Bent starboard landing skid. Bent engine support arm.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight

RYAN FLIGHT NO. 15

1. Purpose: To determine the ability of a controller to accurately position the drone over a point target which is visible from the control position.

2. General Information:

a. Date: 13 September 1963
b. Visibility: Dull
c. Temperature: 64°
d. Humidity: 56%
e. Drone No: 4
f. Engine No: 2
g. Camera No: 4
h. Launcher No: 1
i. Controller: AKERS

3. Launch Phase:

a. Launch Position: "B"

b. Launch Personnel: (1) AKERS (2) KREDIET

c. Controller to launch site: 10 meters

d. Time to launch: Not observed.

e. Time of launch: 1642

f. Bearing of launch: 029°

g. Wind at launch site: Gusty 12-15 knots from 010°

h. Wind at 1000 ft: 18 knots from 360° 2000 ft: 15 knots from 010°

REMARKS:

Decrease throttle command did not function during pre-launch test sequence. This situation did not repeat itself on further examination and test.

4. Flight Phase:

a. Target No: 13

b. Range to target: 1400 meters

c. Type target: Point

d. Bearing to target: 063°

e. Target visible to controller?: Yes

f. Maximum range flown: 1400 meters

g. Maximum altitude flown: 2000 feet

h. Photo coverage of target: 100%

REMARKS: Drone had sluggish response to all commands after 6 minutes of flight; no response after 7 minutes of flight. Left turn was last command to which drone responded. Drone continued flight in decending left turn and dropped into wooded area 1400 meters distant. Upon examination of this problem by the contractor it was learned that the power drain of the P-2 camera with a 50 foot magazine is sufficient to drain the drone battery. This would account for the sluggish response to commands after the camera has been used during this and prior flights.

5. Recovery Phase:

a. Total time of flight: 7 minutes 30 seconds

b. Designated recovery point: "B"

c. Distance from designated recovery point to actual recovery point: 1000-1600 meters

d. Damage on recovery: Total wreck of airframe. Split nose cone. Bent wing spreader bar. Propeller broken.

6. Target Observers Comments:

a. Detection of launch: Could hear and see entire launch

b. Detection of drone in flight: Could hear and see entire flight.

REPUBLIC "BIKINI" LAUNCH SEQUENCE

SEQUENCE NO.	TASK
1	Turn on transmitter power.
2	Set up launcher a. Remove launcher legs from trailer. b. Release straps that secure launcher to trailer. c. Slide launcher aft on trailer so that front legs extend over edge. d. Attach front legs. e. Slide launcher off trailer and rest on front legs. f. Attach rear legs. g. Position launcher. h. Loosen 4 tee bolts that secure pressure cylinder. i. Extend pressure cylinder to its stops and secure 4 tee bolts. j. Raise cylinder support and lock clamping device.
3	Assemble drone on launcher a. Loosen straps that secure drone container to trailer. b. Remove container from trailer. c. Open container and remove fuselage. d. Install fuselage on launcher. e. Turn drone power on. f. Remove wings from container. g. Install wings on fuselage. h. Install pip pins to secure wings. i. Remove tail sections from container. j. Install horizontal tail section over 2 alignment dowels on fuselage. k. Install vertical tail section over same dowels and engage rudder control fittings. l. Tighten four captive bolts.
4	Erect Antenna and check remote controls a. Unclamp antenna and erect on jeep. b. Uncoil control box cable. c. Test remote operations of elevator, rudder, throttle, camera and chute deployment.

REPUBLIC "BIKINI" LAUNCH SEQUENCE

SEQUENCE NO.	TASK
5	Start engine and recheck remote controls a. Engage engine starter. b. Pull rope and start engine. c. Return starter to launch position. d. Release choke. e. Recheck remote controls.
6	Pressurize launch system a. Connect supply tank to accumulator. b. Fill accumulator to 75 psi. c. Shut off supply valve.
7	Launch a. Operate launch control lanyard.

RYAN "FLEX-BEE" LAUNCH SEQUENCE

SEQUENCE NO.	TASK
1	Turn on transmitter power.
2	Set up launcher. a. Remove launcher from jeep. b. Open launcher to extended position. c. Attach front legs. d. Position and level launcher. e. Install four hold-down stakes, 2 front and 2 rear.
3	Assemble drone a. Remove drone and wing from jeep. b. Install upper struts on drone. c. Open wing and install wing spreader bar. d. Attach four control cables to wing for roll and pitch control. e. Attach assembled wing to drone upper struts. f. Place drone on launcher and position launch bar and hold-down bar.
4	Erect antenna and check remote controls a. Position antenna on jeep. b. Turn drone power on. c. Test remote operation up-down, left-right, return to neutral, throttle and camera controls. d. Install cartridge in launch system.
5	Start engine and recheck remote controls a. Pull lanyard starter and start engine. b. Recheck remote controls.
6	Launch a. Operate lanyard for cartridge firing pin.

ANNEX B - Deficiencies and Suggested Modifications

1. Correction of the following deficiencies is essential in order to make the item acceptable:

a. Republic "BIKINI"

No.	Deficiency	Suggested Modification
1	Poor obstacle clearance capability	Increase thrust to provide for clearance of 100 foot obstacle in 100 meters under all conditions.
2	Poor rate of climb	Increase capability to provide climb rate of 1000 feet/min.
3	Poor stability in flight	Modify design as required.
4	Consistant tail damage on recovery	Decrease rate of decent or strengthen tail.
5	Very little security in command system	Use "flash command" system.
6	Air accumulator too large	Decrease size of accumulator.
7	Overly sensitive command system	Modify control designs as required.
8	Launcher twist on uneven terrain	Make all legs telescopic and fully adjustable.
9	Limited battery Life	Use small generator with back-up battery.

b. Ryan "FLEX-BEE"

No.	Deficiency	Suggested Modification
1	Recovery System	Consider use of parachute as alternate or primary means of recovery.
2	Very little security in command system	Use "flash command" system.
3	Critical launcher friction	Have uniform friction in launcher.

No.	Deficiency	Suggested Modification
4	Limited battery life	Use small generator with back-up battery.
5	Difficulty in attitude determination at range	Use color contrast code.
6	Excessive engine noise	Install muffler

ANNEX C - PHOTOGRAPHS

1. Appendix 1 is a discussion of the camera used throughout the evaluation.

2. Appendix 2 contains a photograph of the test range showing location and description of launch sites and targets.

3. Appendix 3 contains general ground and aerial photographs taken during the evaluation of Republic "BIKINI".

4. Appendix 4 contains general ground and aerial photographs taken during the evaluation of Ryan "FLEX-BEE".

APPENDICES:

1. Drone Sensor
2. Test Range Description
3. Republic "BIKINI" Photos
4. Ryan "FLEX-BEE" Photos

DRONE SENSOR

1. Discussion:

a. Throughout the period of test both Ryan and Republic used the standard P-2 camera manufactured by J. A. MAURER Inc.; Ryan employed a 50 foot magazine which gave a capability of about 250 exposures, whereas Republic employed the 15 foot magazine, which gave a capability of 80 exposures. These cameras were furnished by the Government.

b. This camera was selected because it was readily available, but from the start of the tests it was apparent that it was not suitable for use with slow flying drones. First, a recycle speed of .16 seconds provided only 36 seconds of photography for the Ryan "FLEX-BEE" and 12 seconds of photography for Republic "BIKINI". Because of this, it was impossible to accurately determine stability from an examination of photographs taken, as these photographs had over 95% overlap. Moreover, the 3.1 inch focal length of the camera would furnish a photograph of an area only 220 x 220 meters from 1000 feet, making the ability of the controller to accurately position the drone over a point target extremely critical, and providing very limited coverage for area targets.

c. During the period of the tests, J. A. MAURER, Inc., provided the Marine Corps with a P-220 camera, with a 1-1/2 inch focal length lens. This proved very satisfactory in that a photograph taken with this camera from 2000 feet would provide coverage of an area about 900 x 900 meters. The lens of this camera had 36% more resolving power than the P-2 lens, making identification of ground targets much easier.

2. Recommendations: That any camera considered for use with lightweight battlefield surveillance drones have:

a. A maximum focal length 1-1/2 inches.

b. A recycle rate of 1 frame every 5 seconds.

c. A lens capable of resolving 1 foot on the ground from an altitude of 2000 feet.

P-2 CAMERA

GENERAL CHARACTERISTICS

1. Focal length: 3.1 inches (80mm) (1.5 inch (38mm) lens available).

2. Lens speed: F:2.8

3. Angle of view: 40 degrees (90 degrees with 38mm lens).

4. Area coverage at 10,000 feet altitude: 1.37 x 1.37 miles (2.74 x 2.74 miles with 38mm lens).

5. Shutter data:

   Type: Focal plane

   Speed: 1/500, 1/1000, 1/2000

6. Camera operation:

   Type of operation: Pulse or intervalometer

   Electrical requirements: 4.3 amps, 28 volts DC

   Minimum recycle: .16 seconds (6 frames per second runaway)

7. Magazine data:

   Type: Removable

   Negative size: 2-1/4 x 2-1/4 inches

   Maximum film load: 50 feet of 70mm film

   Maximum number of exposures: 250

8. Weight: 10.5 pounds w/50 foot magazine.

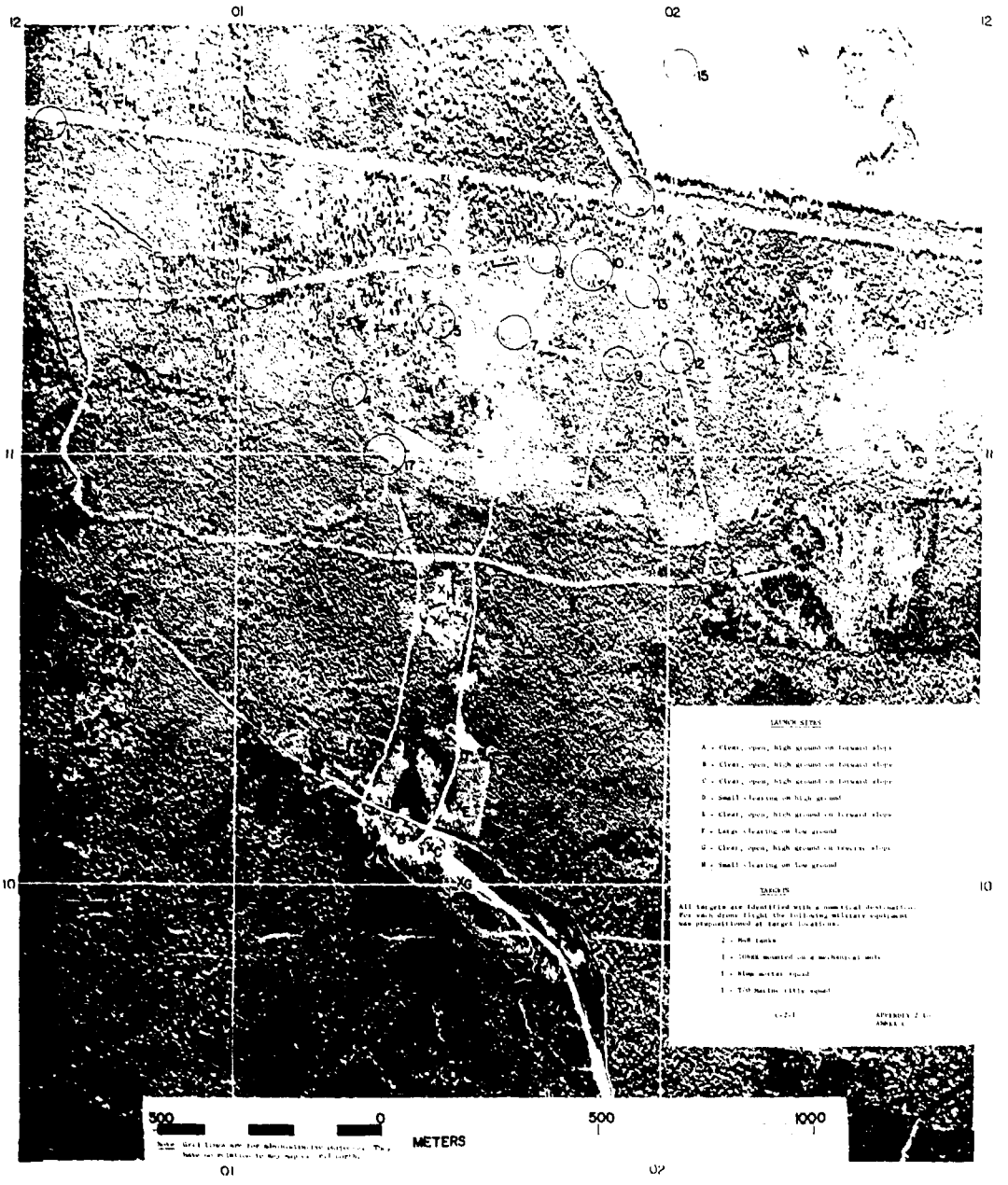
9. Dimensions: 4 x 4 x 9-1/2 inches w/50 foot magazine.

10. Manufacturer: J. A. MAURER, Inc.

P-2 CAMERA

GROUND COVERAGE FOR VARIOUS ALTITUDES

	GROUND COVERAGE	
ALTITUDE IN FEET	80mm Lens METERS	40mm Lens METERS
250	55 x 55	110 x 110
500	110 x 110	220 x 220
750	165 x 165	330 x 330
1,000	220 x 220	440 x 440
1,250	275 x 275	550 x 550
1,500	330 x 330	660 x 660
2,000	440 x 440	880 x 880
3,000	660 x 660	1320 x 1320
4,000	880 x 880	1760 x 1760
5,000	1100 x 1100	2200 x 2200
6,000	1320 x 1320	2640 x 2640
7,000	1540 x 1540	3080 x 3080
8,000	1760 x 1760	3520 x 3520
9,000	1980 x 1980	3960 x 3960
10,000	2200 x 2200	4400 x 4400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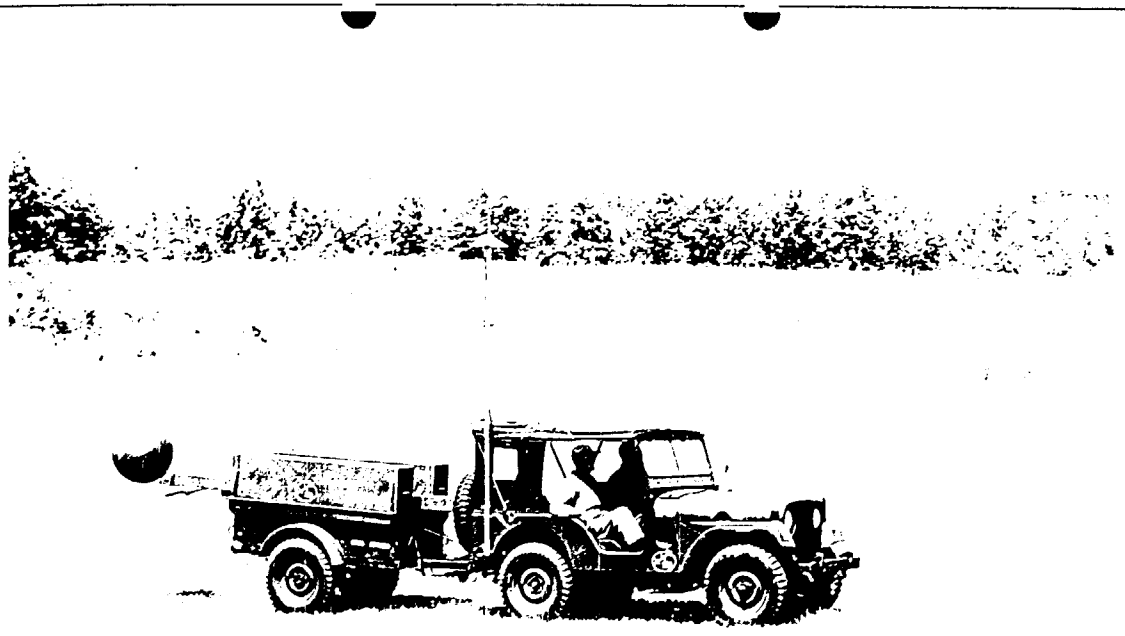
01
02
12
11
10
LAUNCH SITES
TARGETS
500
0
500
1000
METERS
01
02



JEEP AND TRAILER TRANSPORT OF REPUBLIC
"BIKINI" DRONE SYSTEM

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ANNEX C

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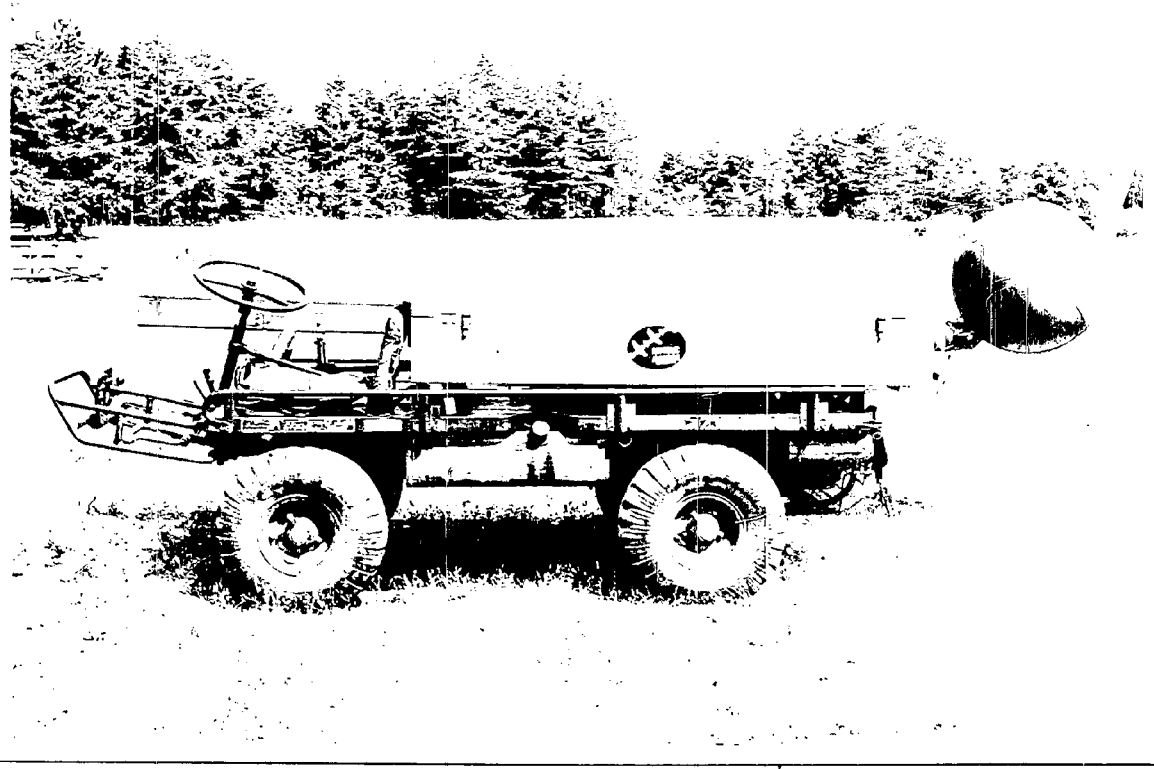
Project No. 20-63-01
Page C-3-1 Fig 1



MECHANICAL MULE TRANSPORT OF REPUBLIC
"BIKINI" DRONE SYSTEM

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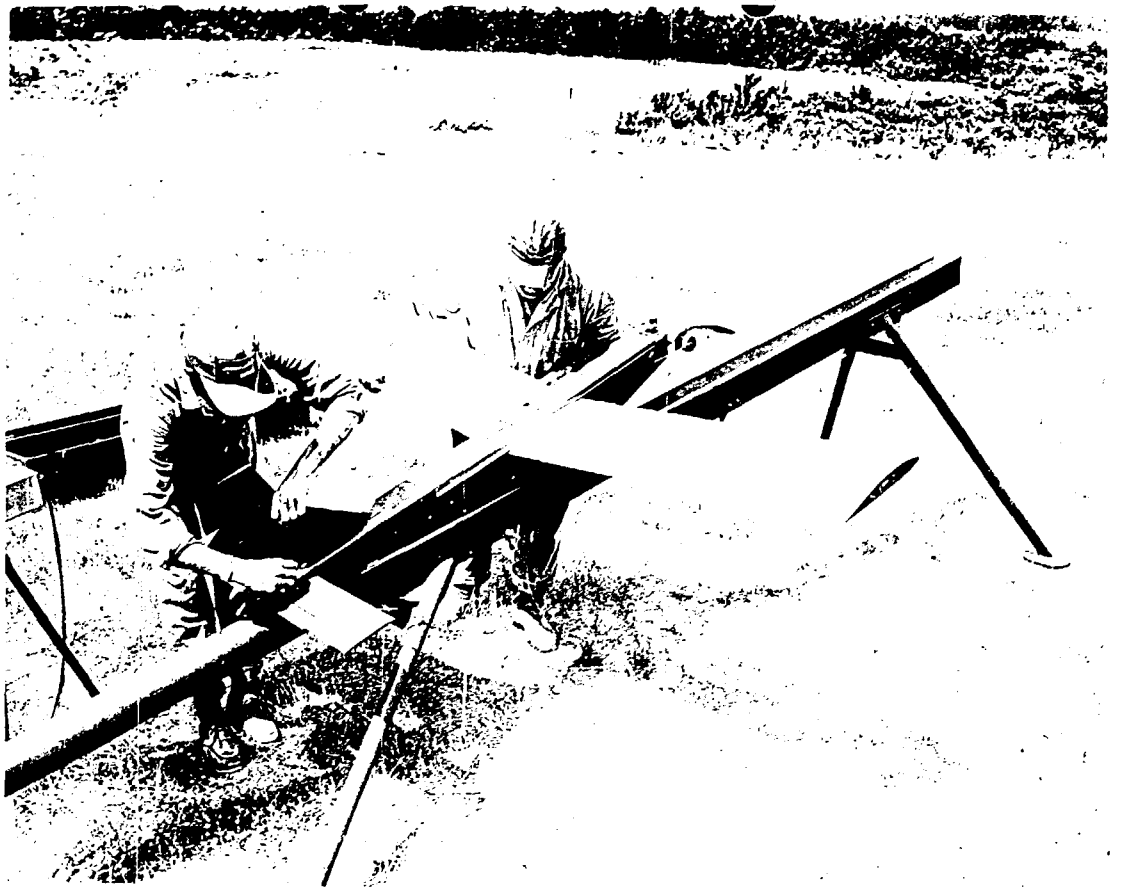
Page C-3-2

Fig 2



FINAL ASSEMBLY OF REPUBLIC "BIKINI" DRONE ON LAUNCHER

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Fig 3

LAUNCH OF REPUBLIC "BIKINI" DRONE

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Page C-3-4

Fig 4

REPUBLIC "BIKINI" GROUND CONTROL STATION

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Fig 5

REPLACEMENT OF BROKEN PROPELLER ON REPUBLIC "BIKINI" DRONE. CAUSED WHEN DRONE CAME LOOSE ON LAUNCHER AND TIPPED FORWARD.

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Page C-3-6

Fig 6

PARACHUTE RECOVERY OF REPUBLIC "BIKINI" DRONE

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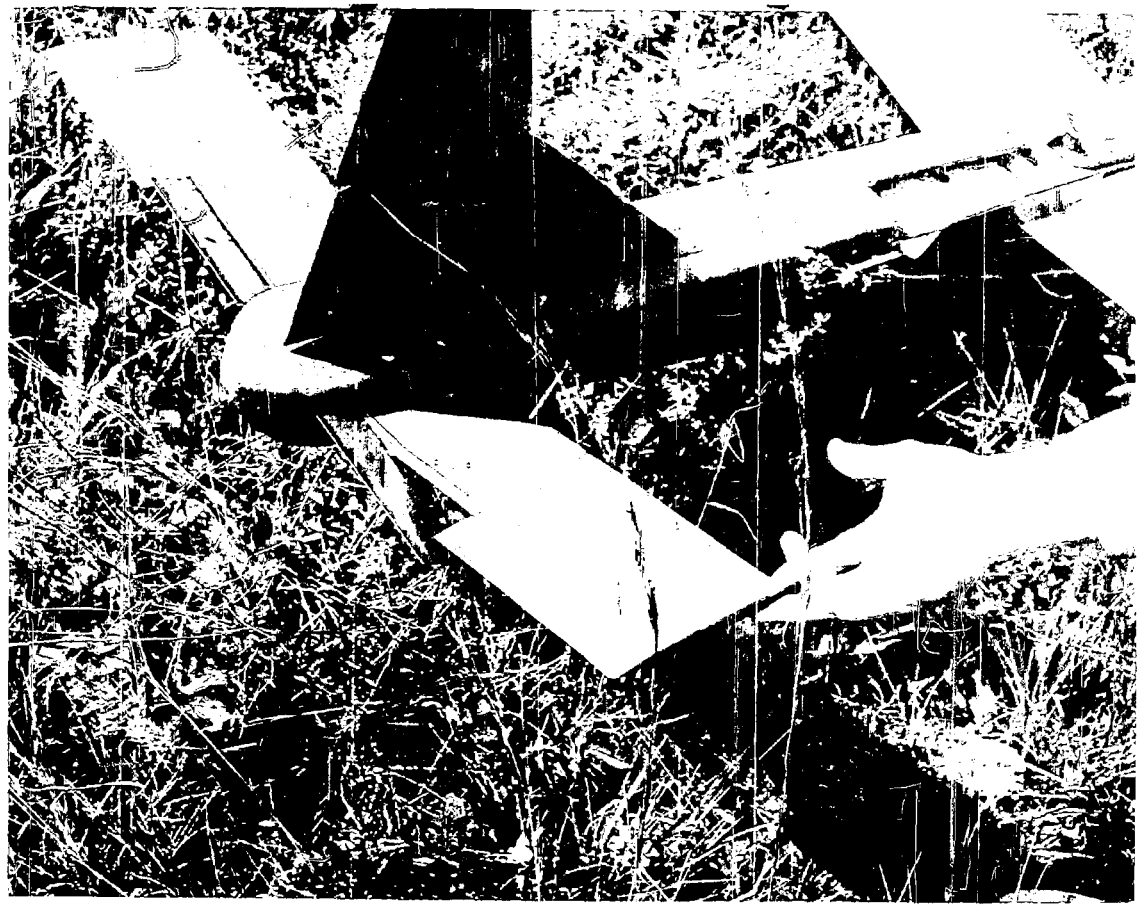
Page C-3-7

Fig 7



BREAK OF REPUBLIC "BIKINI" HORIZONTAL TAIL
RESULTING FREQUENTLY FROM LANDING IMPACT

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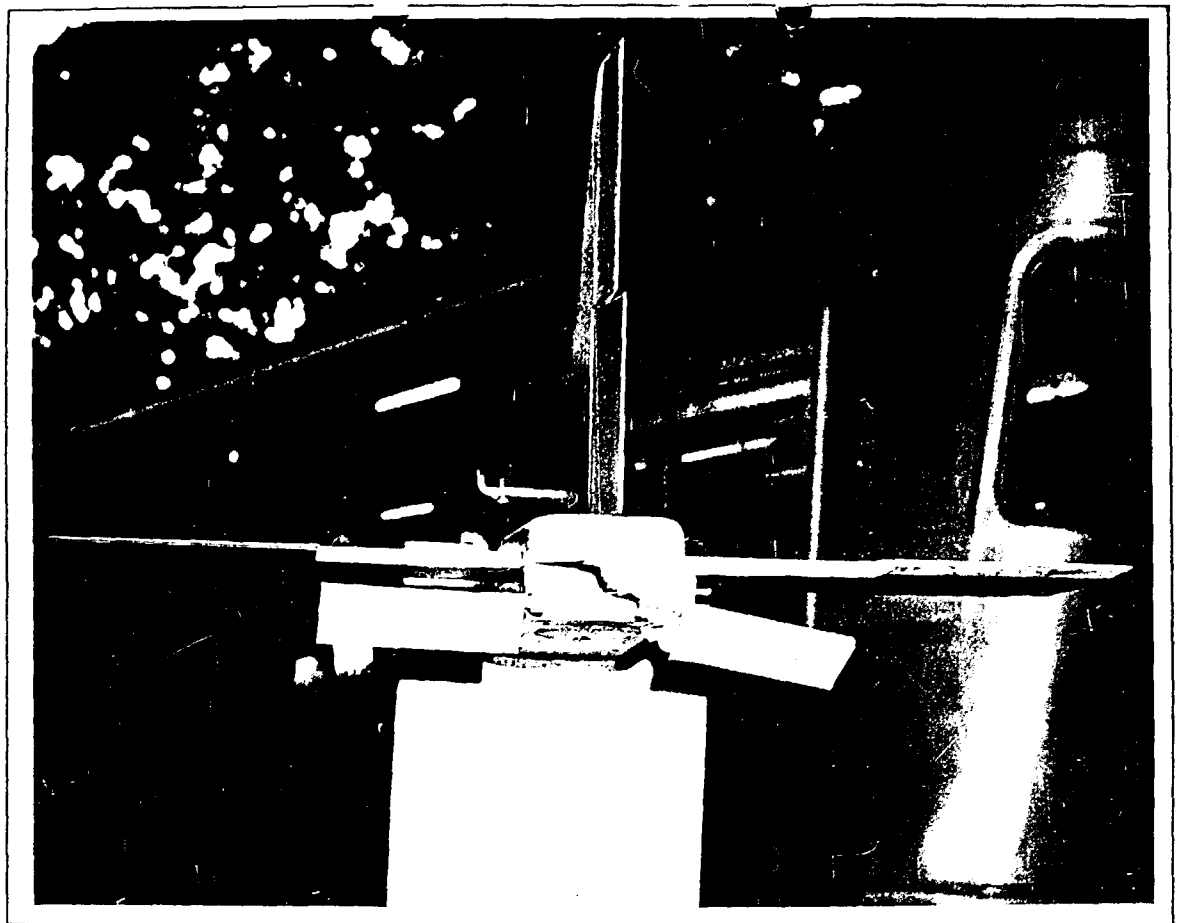
Project No. 20-63-01
Page C-3-8 Fig 8



REPUBLIC "BIKINI" TAIL BROKEN FROM LANDING IMPACT

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REPUBLIC "BIKINI" PROPELLER BROKEN FROM LANDING IMPACT

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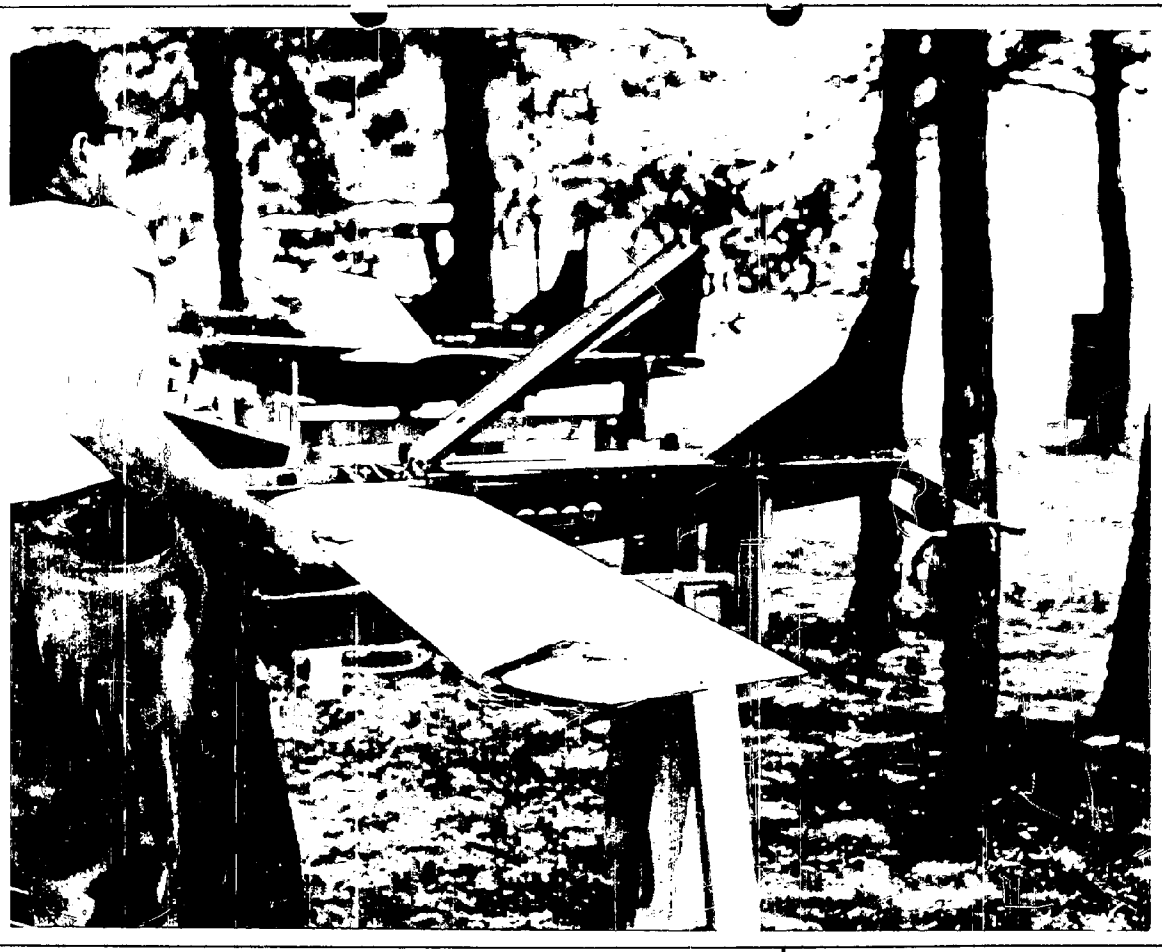
Page C-3-11

Fig 11



WING DAMAGE TO REPUBLIC "BIKINI" CAUSED BY IMPACT WITH TREE SHORTLY AFTER LAUNCH

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Fig 12

REPUBLIC "BIKINI" FUSELAGE CRACKED FROM LANDING IMPACT

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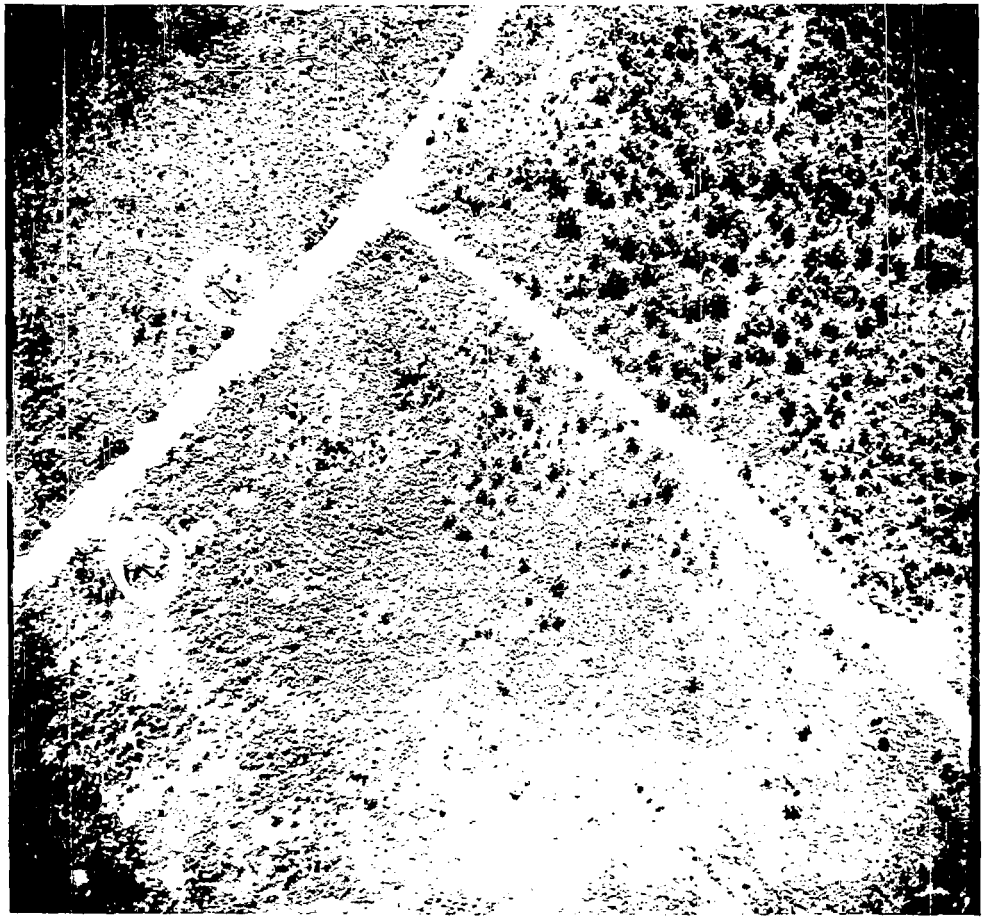
Project No. 20-63-01
Page C-3-13

Fig 13



REPUBLIC "BIKINI" AERIAL PHOTO--FLIGHT NO. 1
ALTITUDE - 1000 FEET

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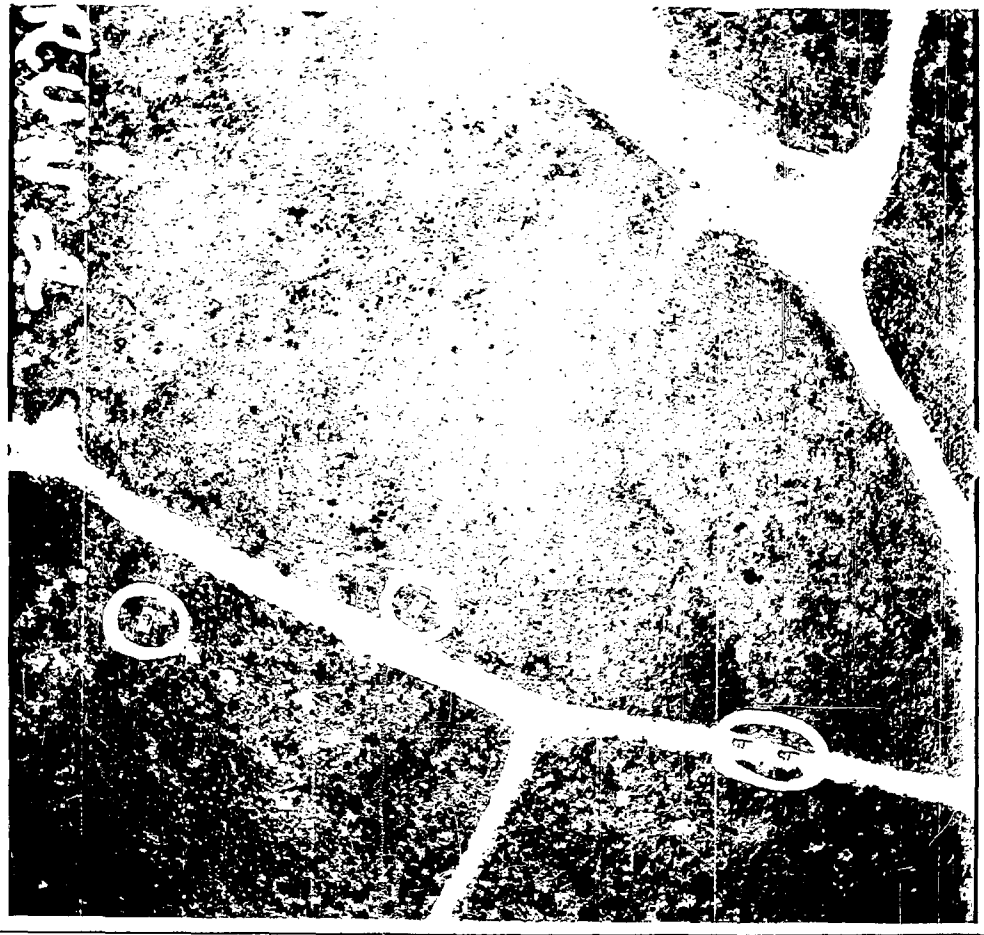
Page C-3-14

Fig 14



REPUBLIC "BIKINI" AERIAL PHOTO--FLIGHT NO. 2
ALTITUDE -- 1500 FEET

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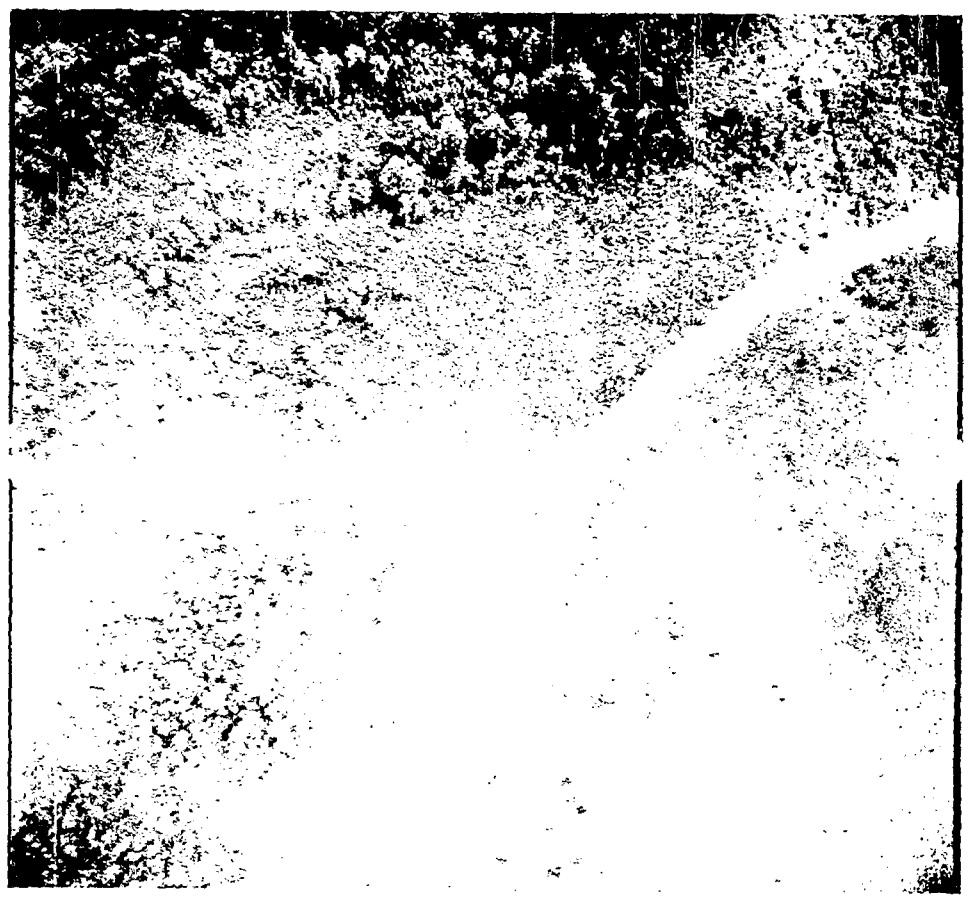
Fig 15



REPUBLIC "BIKINI" AERIAL PHOTO--FLIGHT NO. 4
ALTITUDE - 1000 FEET

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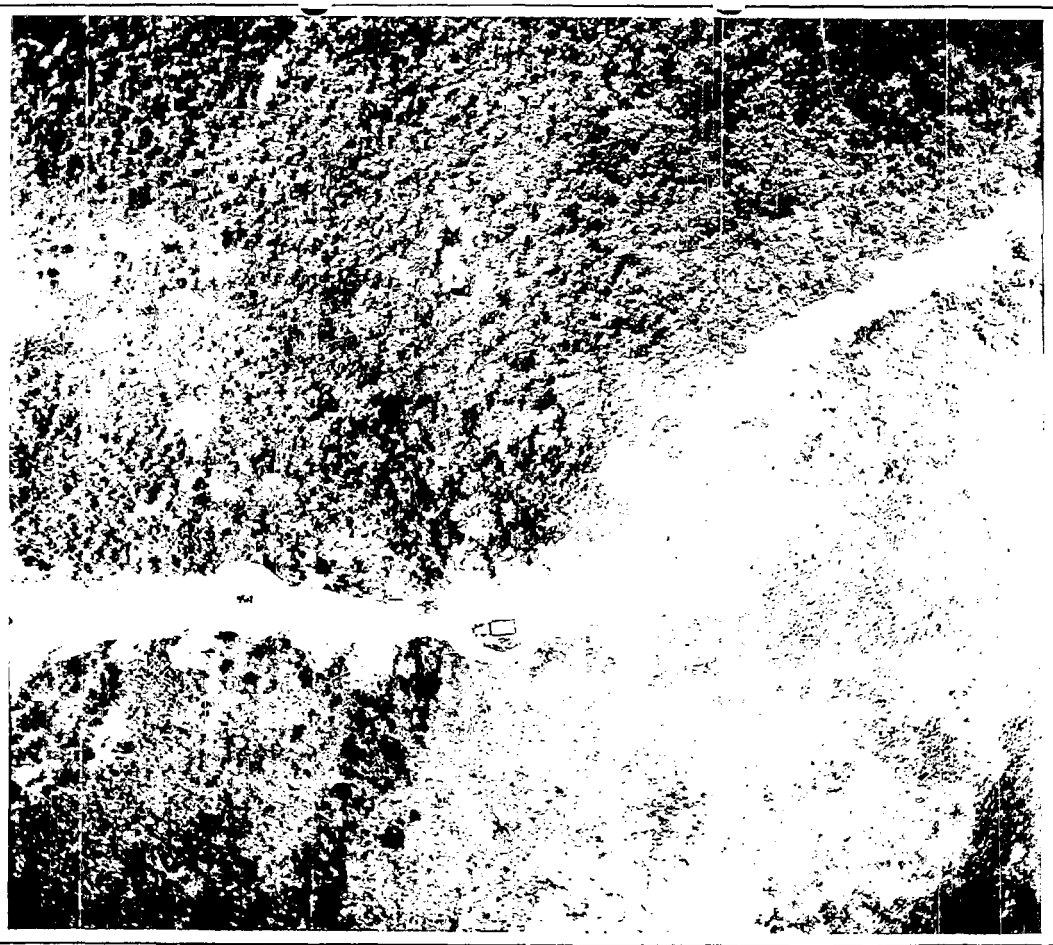
Fig 16



REPUBLIC "BIKINI" AERIAL PHOTO--FLIGHT NO. 12
ALTITUDE - 800 FEET

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Fig 17

RYAN "FLEX-BEE" DRONE SYSTEM IN PREPARATION FOR LAUNCH

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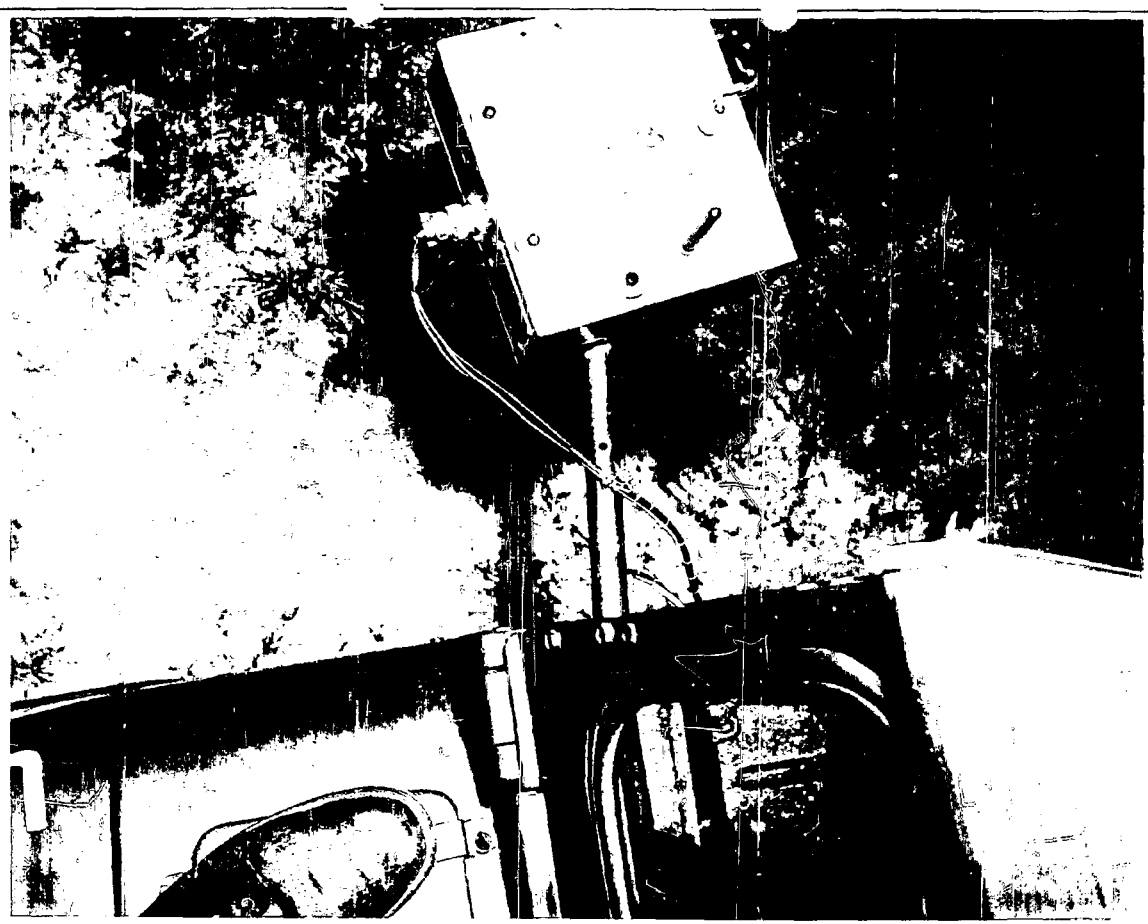
Fig 1



CONTROL BOX FOR RYAN "FLEX-BEE" COMMAND SYSTEM

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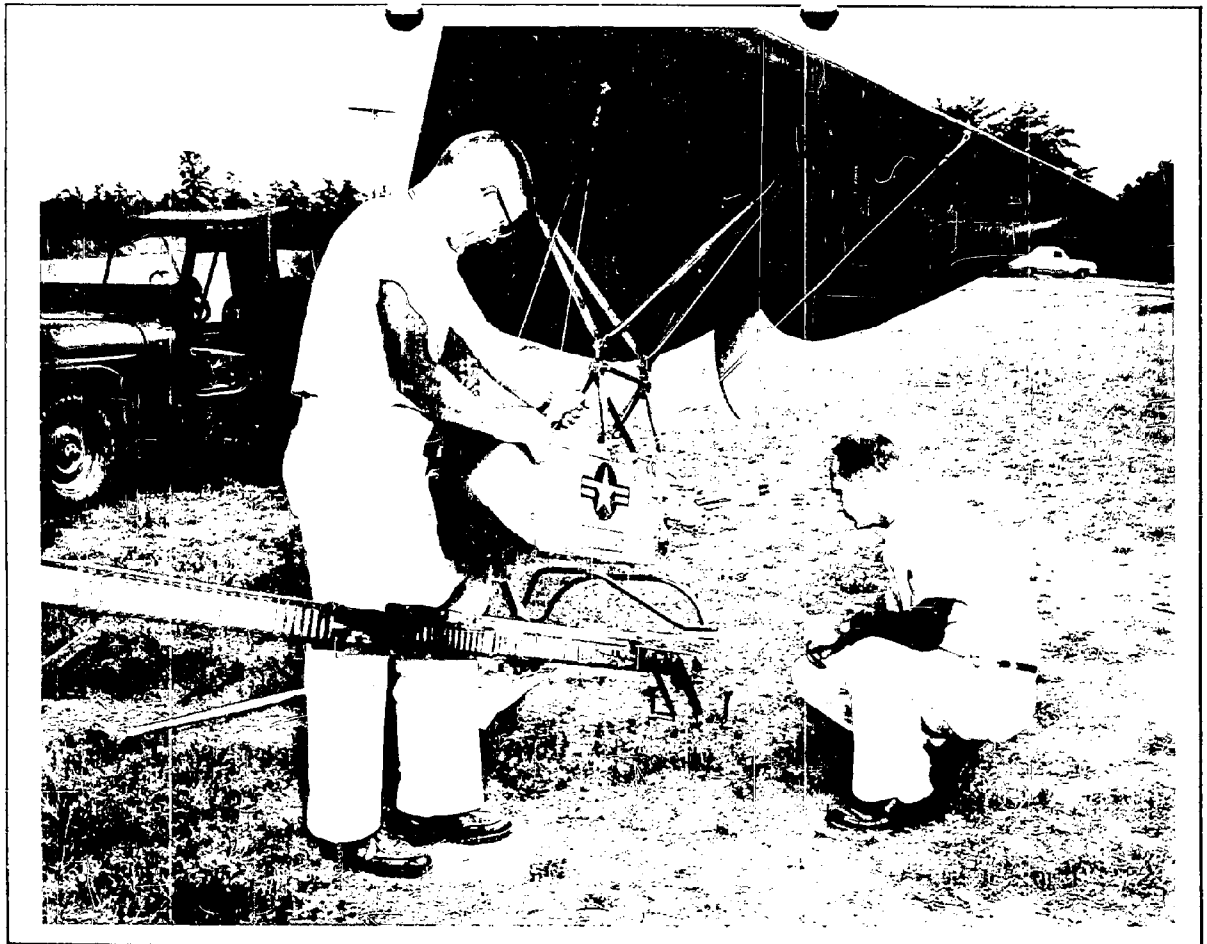
Page C-4-2 Fig 2



FINAL PREPARATION FOR LAUNCH OF RYAN "FLEX-BEE" DRONE

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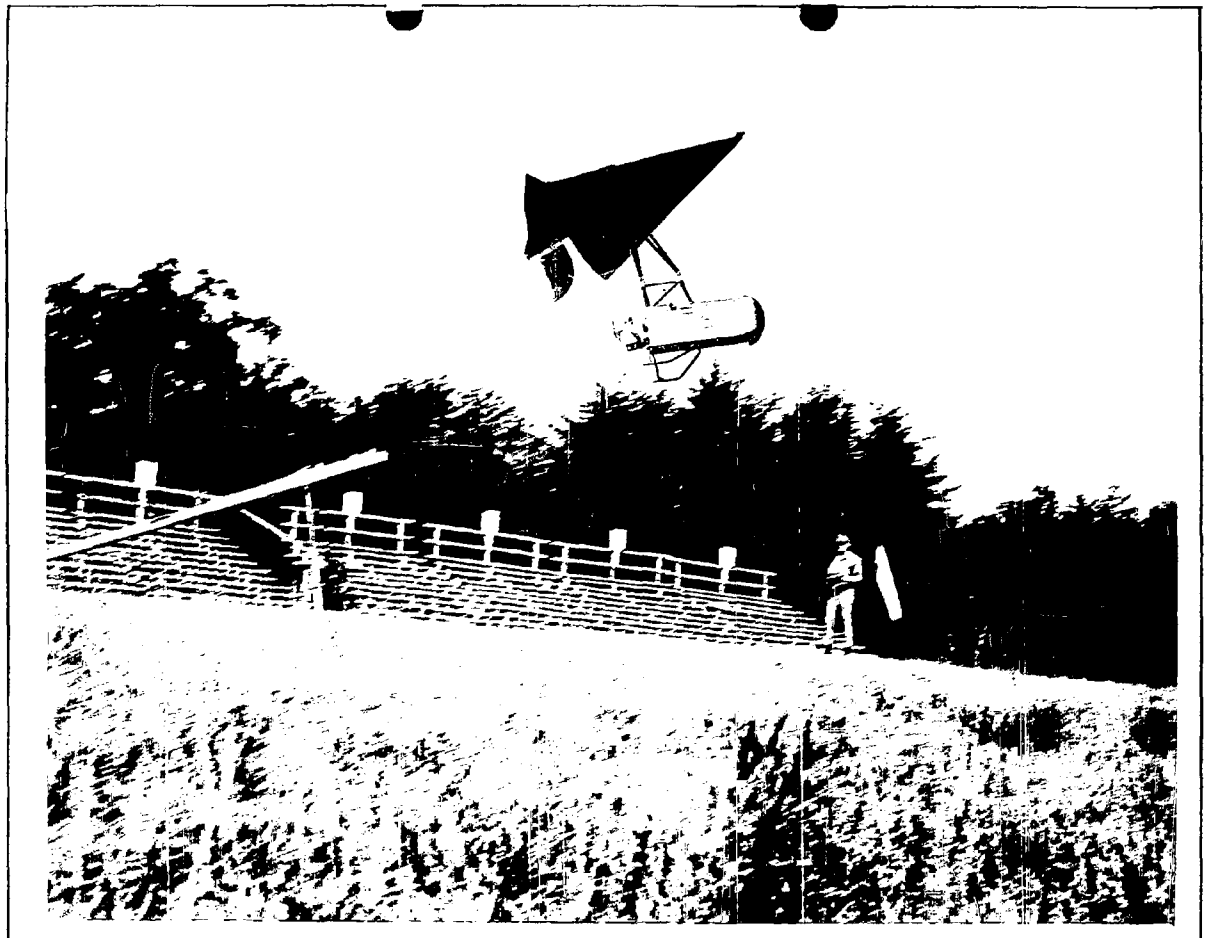
Fig 3



LAUNCH OF RYAN "FLEX-BEE" DRONE

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Fig 4

RECOVERY OF RYAN "FLEX-BEE" DRONE

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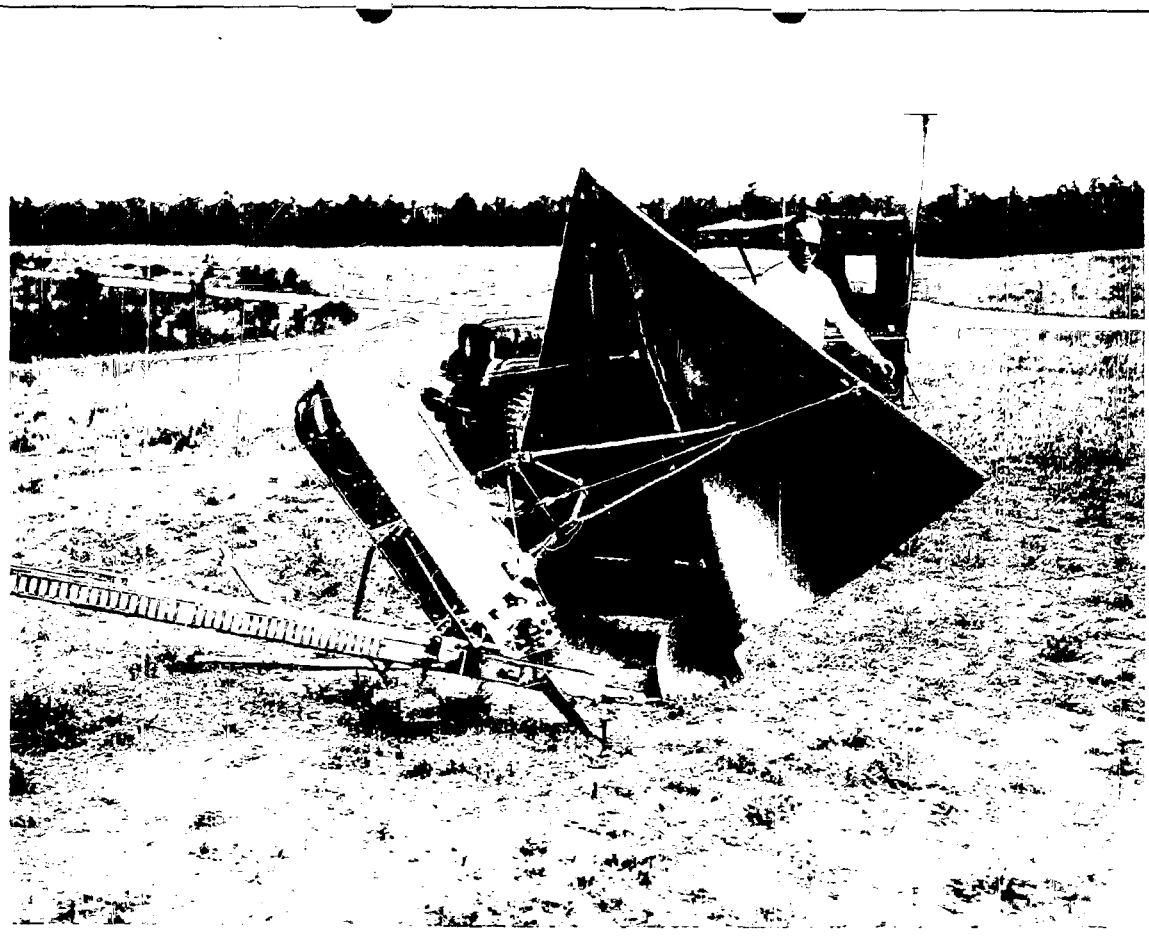
Fig 5



RYAN "FLEX-BEE" DRONE AFTER COMING LOOSE FROM FORWARD RETAINING BAR ON LAUNCHER

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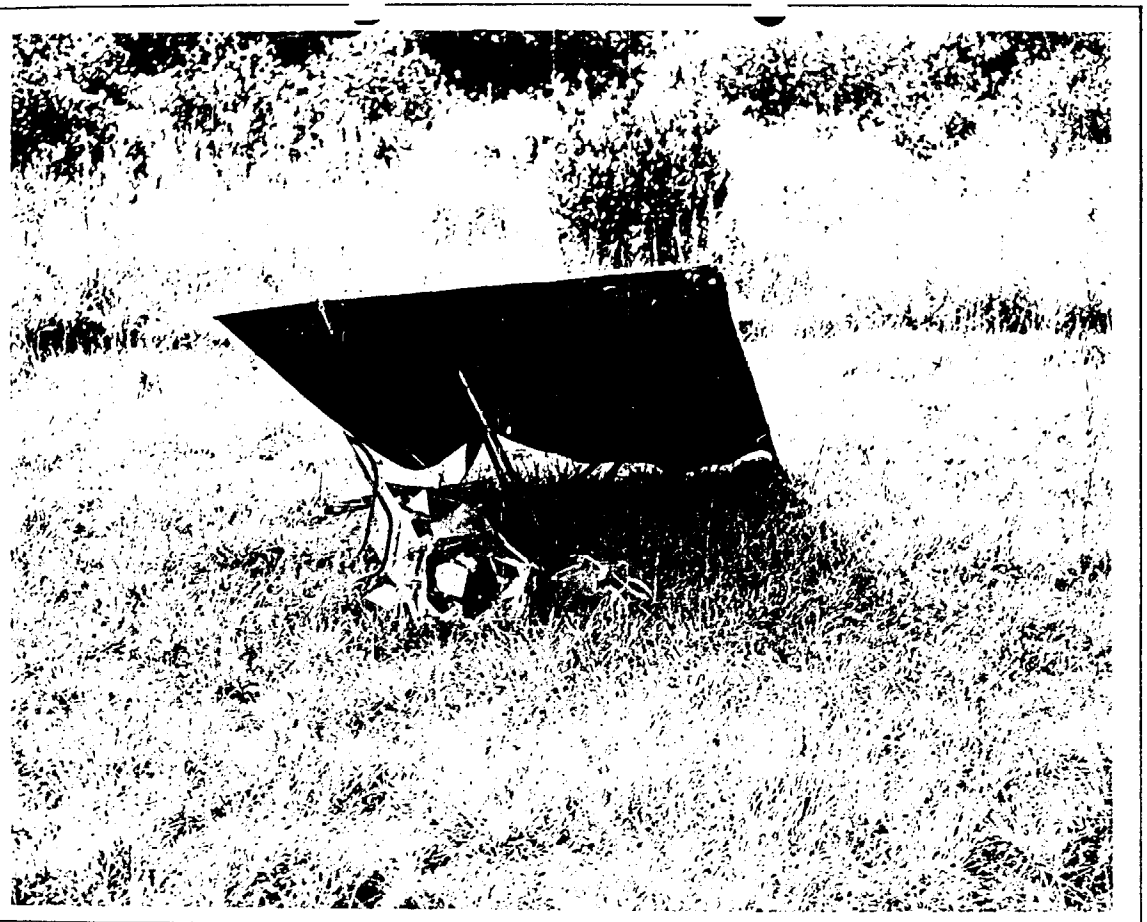

DAMAGE TO RYAN "FLEX-BEE" AFTER UNCONTROLLED RECOVERY

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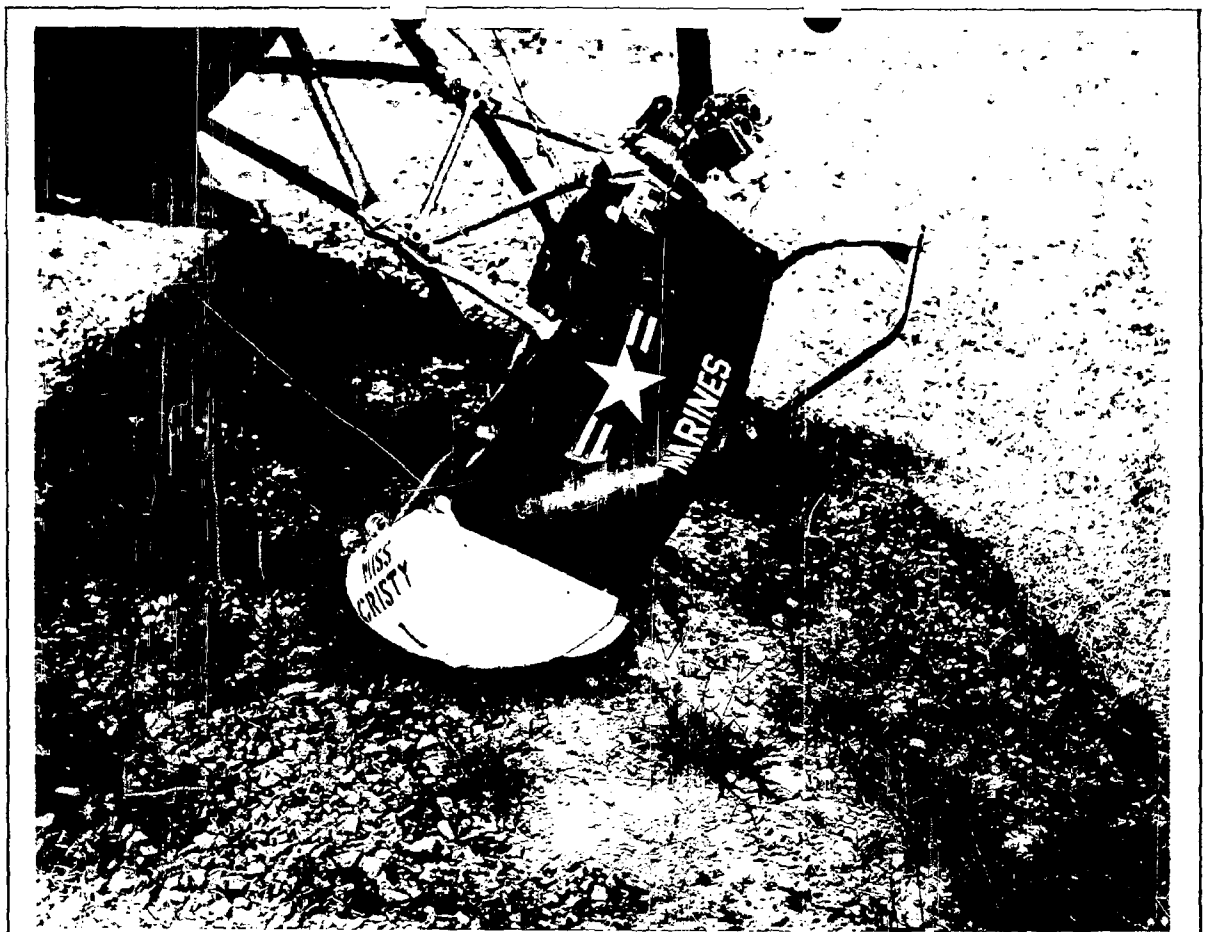

DAMAGE TO RYAN "FLEX-BEE" FROM CRASH JUST AFTER LEAVING LAUNCHER

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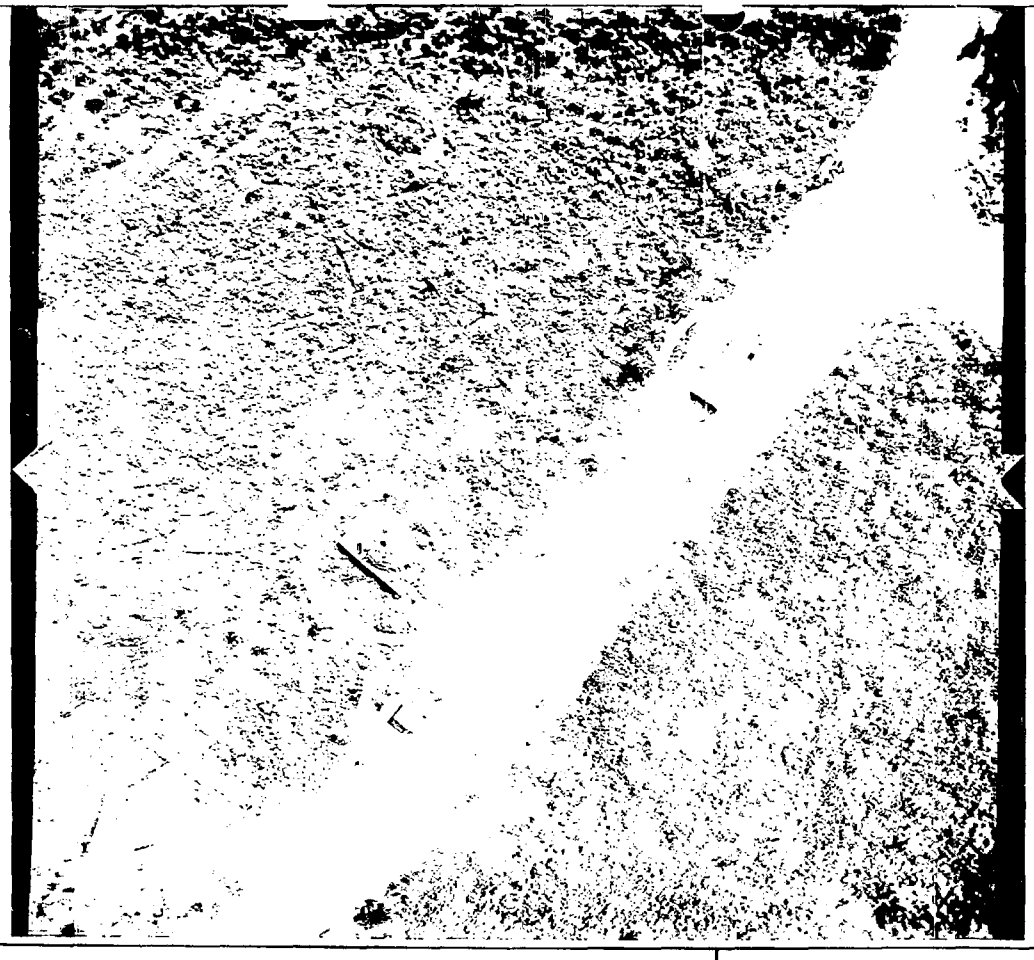
Fig 8



RYAN "FLEX-BEE" AERIAL PHOTO--FLIGHT NO. 1
ALTITUDE - 500 FEET

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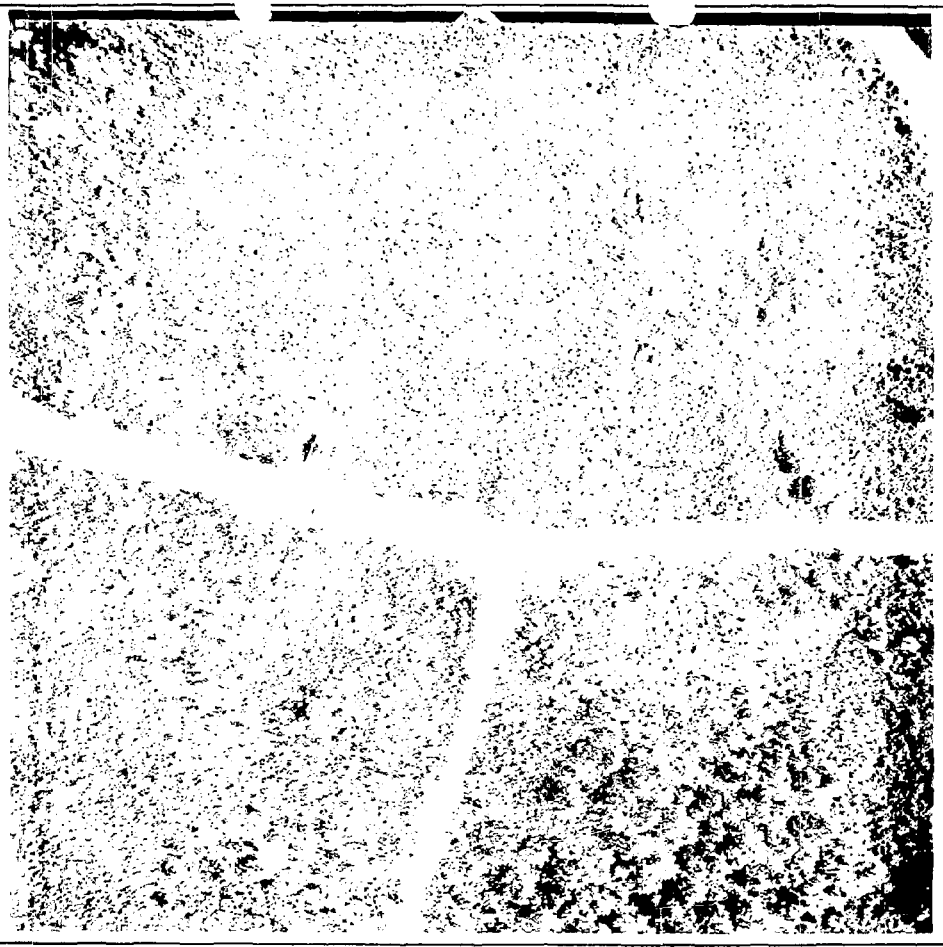
Fig 9



RYAN "FLEX-BEE" AERIAL PHOTO--FLIGHT NO. 9
ALTITUDE - 800 FEET

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Fig 10

RYAN "FLEX-BEE" AERIAL PHOTO--FLIGHT NO. 14
ALTITUDE - 1000 FEET

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Fig 11

ANNEX D - SUPPLEMENTARY REPUBLIC FLIGHTS

1. During the period 29 July - 1 August 1963, Republic Aircraft Corporation conducted 17 additional flights at R-4 Range, Marine Corps Schools, Quantico, Virginia. These flights were not part of the formal comparative evaluation, but, rather, were made in an attempt to gather more data and evaluate additional techniques.

2. As a result of these flights it was determined that:

a. The maximum endurance of the "Bikini" drone which can be expected with the current 40 ounce fuel cell is 30 minutes.

b. The maximum altitude at which the "Bikini" drone can be controlled visually is 2500 feet.

c. The average speed of the "Bikini" drone on full throttle is 80 mph.

d. That message delivery flights using the "Bikini" drone are possible, but accuracy of hitting a specific point diminishes with range and depends upon the altitude the parachute is activated and existing wind conditions.

e. That "hand-off" flights between controllers are feasible, but not with the existing radio command system because of the "fail-safe" activation of the parachute after loss of carrier signal for more than three seconds.

APPENDIX 1 - Republic Flight Fact Sheets

REPUBLIC FLIGHT NO. 2-1

1. Purpose: To determine endurance and maximum altitude at which drone can be controlled.

2. General Information:

a. Date: 29 July 1963	h. Engine No: 107
b. Visibility: High cloud cover	g. Camera No: Not applicable
c. Temperature: 90°	h. Launcher No: 2
d. Humidity: 47%	i. Controller: LOANE
e. Drone No: 4	

3. Results:

a. Endurance

Total time of flight - 25 minutes 29 seconds

Total fuel consumed - 33 ounces

Average fuel consumed/min of flight - 1.3 ounces

b. Rate of Climb:

1000 feet - 5 minutes

1500 feet - 7 minutes

2000 feet - 9 minutes (2500 feet is maximum altitude for effective visual control)

3000 feet - 11 minutes

3500 feet - 15 minutes

4. Remarks:

a. Lack of fuel pressure required change of gasoline tank.

b. Broken connection on gas regulator required replacement of drone on launcher.

REPUBLIC FLIGHT NO. 2-3

1. Purpose: To determine endurance.

2. General Information:

   a. Date: 29 July 1963
   b. Visibility: Clear
   c. Temperature: 85°
   d. Humidity: 55%
   e. Drone No: 7
   f. Engine No: 106
   g. Camera No: None
   h. Launcher No: 2
   i. Controller: LOANE

3. Results:

   a. Endurance

      Total time of flight - 23 minutes 41 seconds

      Total fuel consumed - 28 ounces

      Average fuel consumed/min of flight - 1.2 ounces

REPUBLIC FLIGHT NO. 2-5

1. Purpose: To determine endurance and maximum altitude at which drone can be controlled.

2. General Information:

a. Date: 30 July 1963

b. Visibility: Clear

c. Temperature: 88°

d. Humidity: 46%

e. Drone No: 6

f. Engine No: 110

g. Camera No: Wide angle

h. Launcher No: 2

i. Controller: LOANE

3. Results:

a. Endurance

Total time of flight - 26 minutes 35 seconds

Total fuel consumed - 30 ounces

Average fuel consumed/min of flight - 1.14

b. Rate of Climb:

1000 feet - 3 minutes 30 seconds

1500 feet - 5 minutes 45 seconds

2000 feet - 7 minutes 15 seconds

2500 feet - 9 minutes 45 seconds (Maximum altitude for effective visual control)

3000 feet - Not reached

REPUBLIC FLIGHT NO. 2-7

1. Purpose: Demonstration flight.

2. General Information:

a. Date: 31 July 1963	f. Engine No: 104
b. Visibility: Clear	g. Camera No: None
c. Temperature: 74°	h. Launcher No: 2
d. Humidity: 65%	i. Controller: LOANE
e. Drone No: 4	

3. Remarks:

a. Cracked fuselage one foot from tail from landing impact.

REPUBLIC FLIGHT NO. 2-1

1. Purpose: To determine endurance and maximum altitude at which drone can be controlled.

2. General Information:

a. Date: 29 July 1963

b. Visibility: High cloud cover

c. Temperature: 90°

d. Humidity: 47%

e. Drone No: 4

h. Engine No: 107

g. Camera No: Not applicable

h. Launcher No: 2

i. Controller: LOANE

3. Results:

a. Endurance

Total time of flight - 25 minutes 29 seconds

Total fuel consumed - 33 ounces

Average fuel consumed/min of flight - 1.3 ounces

b. Rate of Climb:

1000 feet - 5 minutes

1500 feet - 7 minutes

2000 feet - 9 minutes (2500 feet is maximum altitude for effective visual control)

3000 feet - 11 minutes

3500 feet - 15 minutes

4. Remarks:

a. Lack of fuel pressure required change of gasoline tank.

b. Broken connection on gas regulator required replacement of drone on launcher.

REPUBLIC FLIGHT NO. 2-2

1. Purpose: To evaluate P-220 Camera with 1-1/2" focal length lens.

2. General Information:

a. Date: 29 July 1963	f. Engine No: 110
b. Visibility: Dark with overcast	g. Camera No: Wide Angle
c. Temperature: 87°	h. Launcher No: 2
d. Humidity: 57%	i. Controller: LOANE
e. Drone No: 6	

3. Results: Photos were taken at altitudes of 500, 1000 and 1500 feet. The area of coverage provided by the wide angle lens proved the requirement for such a lens in any drone camera.

4. Remarks:

a. Horizontal stabilizer broken port side and vertical stabilizer retaining glove split from landing impact.

REPUBLIC FLIGHT NO. 2-3

1. Purpose: To determine endurance.

2. General Information:

   a. Date: 29 July 1963
   b. Visibility: Clear
   c. Temperature: 85°
   d. Humidity: 55%
   e. Drone No: 7
   f. Engine No: 106
   g. Camera No: None
   h. Launcher No: 2
   i. Controller: LOANE

3. Results:

   a. Endurance

      Total time of flight - 23 minutes 41 seconds

      Total fuel consumed - 28 ounces

      Average fuel consumed/min of flight - 1.2 ounces

REPUBLIC FLIGHT NO. 2-4

1. Purpose: To determine feasibility of using drone for message delivery flights.

2. General Information:

a. Date: 30 July 1963

b. Visibility: Clear

c. Temperature: 84°

d. Humidity: 56%

e. Drone No: 7

f. Engine No: 106

g. Camera No: None

h. Launcher No: 2

i. Controller: LOANE

3. Results:

a. Drone was launched from launch site "B" and flown to target No. 13, some 2000 meters away, and controller activated parachute when he thought drone was over target.

b. Due to high winds aloft drone landed in trees 800 meters from proposed recovery point.

4. Remarks:

a. Faulty transmitter required 1/2 hour delay for change during launch phase.

REPUBLIC FLIGHT NO. 2-5

1. Purpose: To determine endurance and maximum altitude at which drone can be controlled.

2. General Information:

a. Date: 30 July 1963

b. Visibility: Clear

c. Temperature: 88°

d. Humidity: 46%

e. Drone No: 6

f. Engine No: 110

g. Camera No: Wide angle

h. Launcher No: 2

i. Controller: LOANE

3. Results:

a. Endurance

Total time of flight - 26 minutes 35 seconds

Total fuel consumed - 30 ounces

Average fuel consumed/min of flight - 1.14

b. Rate of Climb:

1000 feet - 3 minutes 30 seconds

1500 feet - 5 minutes 45 seconds

2000 feet - 7 minutes 15 seconds

2500 feet - 9 minutes 45 seconds (Maximum altitude for effective visual control)

3000 feet - Not reached

REPUBLIC FLIGHT NO. 2-6

1. Purpose: To determine the speed of the drone over a closed course. Time was recorded on out-bound and in-bound legs between launch site "B" and Target No. 14 (a distance of 1400 meters).

2. General Information:

a. Date: 30 July 1963

b. Visibility: Clear

c. Temperature: 84°

d. Humidity: 46%

e. Drone No: 1

f. Engine No: 109

g. Camera No: None

h. Launcher No: 2

i. Controller: LOANE

3. Results:

	OUTBOUND	INBOUND
1.	39 sec.	42 sec.
2.	43 sec.	30 sec.
3.	41 sec.	not recorded
4.	44 sec.	29 sec.
	167 sec.	101 sec.

APPROXIMATE AVERAGE SPEED - 80 MPH

REPUBLIC FLIGHT NO. 2-7

1. Purpose: Demonstration flight.

2. General Information:

   a. Date: 31 July 1963
   b. Visibility: Clear
   c. Temperature: 74°
   d. Humidity: 65%
   e. Drone No: 4
   f. Engine No: 104
   g. Camera No: None
   h. Launcher No: 2
   i. Controller: LOANE

3. Remarks:

   a. Cracked fuselage one foot from tail from landing impact.

REPUBLIC FLIGHT NO. 2-8

1. Purpose: To determine endurance and familiarize Marine personnel with control techniques.

2. General Information:

a. Date: 31 July 1963

b. Visibility: Clear

c. Temperature: 79°

d. Humidity: 53%

e. Drone No: 5

f. Engine No: 107

g. Camera No: None

h. Launcher No: 2

i. Controller: LOANE

3. Results:

a. Endurance

Total time of flight - 33 minutes 20 seconds.

Total fuel consumed - 39 ounces.

Average fuel consumed/min of flight - 1.11 ounces.

b. Two Marine Officers and two civilians flew "Bikini" for short periods under the close supervision of Mr. Marsh LOANE, Republic's controller.

REPUBLIC FLIGHT NO. 2-9

1. Purpose: To familiarize Lt.(Jg) Richard Eskew, drone pilot on loan from VU-6, with the control aspects of the "Bikini" drone, and to further determine endurance.

2. General Information:

a. Date: 31 July 1963

b. Visibility: Dull

c. Temperature: 85°

d. Humidity: 44%

e. Drone No: 5

f. Engine No: 107

g. Camera No: None

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. Lt. Eskew assumed control of "Bikini" for short periods during this flight under the close supervision of Mr. Loane.

b. Endurance

Total time of flight - 29 minutes 32 seconds

Total fuel consumed - 38½ ounces

Average fuel consumed/min of flight - 1.3 ounces

4. Remarks:

a. Vertical tail delaminated and pulled from retaining glove on recovery.

REPUBLIC FLIGHT NO. 2-10

1. Purpose: Practice flight for close range hand-off between LOANE and ESKEW. Control boxes were located side-by-side.

2. General Information:

a. Date: 31 July 1963

b. Visibility: Clear

c. Temperature: 86°

d. Humidity: 42%

e. Drone No: 3

f. Engine No: 102

g. Camera No: None

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. No response to right turn command after take-off. Flight aborted and parachute activated after 30 seconds of flight.

REPUBLIC FLIGHT NO. 2-11

1. Purpose: Practice flight for close range hand-offbetween LOANE and ESKEW. Control boxes were located side-by-side.

2. General Information:

a. Date: 31 July 1963

b. Visibility: Clear

c. Temperature: 86°

d. Humidity: 48%

e. Drone No: 1

f. Engine No: 109

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. Drone left launcher and could not gain altitude. Flew at altitude of 15-20 feet prior to impacting with trees 100 meters away.

b. Extreme damage to the empennage.

REPUBLIC FLIGHT NO. 2-12

1. Purpose: Practice flight for close range hand-off between Loane and Eskew. Control boxes were located side-by-side.

2. General Information:

a. Date: 1 August 1963

b. Visibility: Clear

c. Temperature: 81°

d. Humidity: 64%

e. Drone No: 5

f. Engine No: 107

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. Republic representatives requested that only one transmitter be on the air at a time to preclude a possible premature activation of the recovery parachute. Since the parachute will activate automatically if the carrier signal is lost for longer than three seconds, this required a count-down for the two controllers to insure simultaneous turning off of one transmitter and turning on of the other.

4. Remarks:

A. Fuselage split two feet from tail on recovery.

REPUBLIC FLIGHT NO. 2-13

1. Purpose: Practice flight for close range hand-off between Loane and Eskew. Control boxes were located side-by-side.

2. General Information:

a. Date: 1 August 1963

b. Visibility: Clear

c. Temperature: 84°

d. Humidity: 66%

e. Drone No: 4

f. Engine No: 104

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: Loane and Eskew

3. Results:

a. Republic representatives requested that only one transmitter be on the air at a time to preclude a possible premature activation of the recovery parachute. Since the parachute will activate automatically if the carrier signal is lost for longer than three seconds, this required a count-down for the two controllers, to insure simultaneous turning off of one transmitter and turning on of the other.

REPUBLIC FLIGHT NO. 2-14

1. Purpose: Practice flight for close range hand-off between LOANE and ESKEW. Control boxes were located side-by-side.

2. General Information:

a. Date: 1 August 1963

b. Visibility: Clear

c. Temperature: 85°

d. Humidity: 64%

e. Drone No: 4

f. Engine No: 104

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. Controller aborted flight after one minute of flight. No apparent cause determined.

REPUBLIC FLIGHT NO. 2-15

1. Purpose: Remote hand-off flight between LOANE and ESKEW. LOANE was located at launch site "B" and controlled during launch. He then flew drone in direction of ESKEW who was located 1400 meters away at target No. 13. After a count down by radio, LOANE turned-off his transmitter and ESKEW turned his on and assumed control.

2. General Information:

a. Date: 1 August 1963

b. Visibility: Clear

c. Temperature: 86°

d. Humidity: 64%

e. Drone No: 4

f. Engine No: 104

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. ESKEW controlled the drone for 2 minutes and 30 seconds of flight. He accomplished simple, slow turns and retained the altitude established by LOANE. The drone was then returned to the control of LOANE for recovery.

REPUBLIC FLIGHT NO. 2-16

1. Purpose: Remote hand-off flight between LOANE and ESKEW. LOANE was located at launch site "B" and was to control during launch. He was then to fly drone in direction of ESKEW, who was located 1400 meters away at Target No. 13, who would assume control after count-down.

2. General Information:

a. Date: 1 August 1963

b. Visibility: Clear

c. Temperature: 88°

d. Humidity: 56%

e. Drone No: 4

f. Engine No: 104

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. Drone crashed after leaving the launcher.

b. Severe damage suffered.

REPUBLIC FLIGHT NO. 2-17

1. Purpose: Remote hand-off flight between LOANE and ESKEW. LOANE was located at launch site "B" and controlled during launch. He then flew drone in direction of ESKEW who was located 1400 meters away at Target No. 13, for hand-off of control.

2. General Information:

a. Date: 1 August 1963

b. Visibility: Clear

c. Temperature: 87°

d. Humidity: 63%

e. Drone No: 3

f. Engine No: 103

g. Camera No: For weight only

h. Launcher No: 2

i. Controller: LOANE and ESKEW

3. Results:

a. Parachute activated without command after two minutes of flight. Drone landed in woods approximately 800 meters away and not recovered until next day.

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MCLnO, USA Natick Laboratories	1
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Facsimile Transmittal

30 November 2001

To: **Mr. Larry Downing**

Organization: DTIC
Office Phone:
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From: **Sharon Reinke, Navy Division,**
DFOISR/WHS/DOD

Phone: (703) 697-2716
FAX: (703) 693-7341

Total Pages Transmitted (including cover sheet): 04

Comments: I am forwarding the FOIA request DTIC received, the DTIC forwarding letter, and a list of documents. The documents in the attached list have been released to a FOIA requester [under our case number 01-F-2458] and are, therefore, cleared for public release. If you have questions, give me a call.

AMERICAN LAWYER MEDIA
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01-F-2458

April 11, 2001

Defense Technical Information Center
Attn: Kelly Akers, FOIA Manager
8725 John J. Kingman Road Suite 0944
Fort Belvoir, VA 22060-6218

FOIA REQUEST

Dear Ms. Akers:

American Lawyer Media respectfully requests, under the Freedom of Information Act, a copy of each of the following records:

AD B253477, XV-8A Flexible Wing Aerial Utility Vehicle, by H. Kredit, January 1964, 144 pages

AD B252433, Pilot's Handbook for the Flexible Wing Aerial Utility Vehicle XV-8A, March 1964, 52 pp

AD B200629, Flex Wing Fabrication and Static Pressure Testing, by Larry D. Lucas. June 1995, 80 pages

AD B198352, Materials Analysis of Foreign Produced Flex Wings. by Albert Ingram, march 1995. 16 pp.

AD B131204, Active Flexible Wing Technology, by Gerald D. Miller, Feb. 1988. 256 pages

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We agree to pay up to $200 for costs associated with this request. We are grateful for your kind assistance in this matter. Please contact me at 212-313-9067 if you have any questions relating to our request.

Sincerely,

Michael Ravnitzky
Editor

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